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ELECTRIC STIMULUS TO GROWTH.

The idea that electric stimulation would favorably affect vegetable growth is not new. Nevertheless, many of the early experiments in this line gave results of a somewhat doubtful nature and skepticism has been rather general, in spite of the enthusiastic beliefs of Sir Oliver Lodge and other exponents of the idea.

Recent experiments in this field seem to have dispelled the lingering doubts, however, and on other pages of this issue will be found records of very successful demonstrations which have been made in both England and this country. Not only is the vegetable growth accelerated, but the yield of blossoms and fruit seems to be considerably in excess of that attained under ordinary conditions.

It has been known for some time that the presence of an electrostatic field increases the activity of tissue change, that is, the tearing down of old tissue and the building up of new, and since growth is one manifestation of tissue building, it was naturally to be expected that it would show similar effects. This was demonstrated by Piccinino's experiments on silkworms and Capriati's on tadpoles, both of which grew faster when under the influence of static electricity.

Electric stimulation of growth is thus a property of both vegetable and animal species. That it has a similar effect upon human life is reported from Germany, where experiments were carried out in one of the schools to see whether the children would show any reaction to the presence of an electrostatic field in the schoolroom. It has been reported that not only was there an appreciable acceleration of growth in the children subjected to this influence, but that their mental aptitude was also stimulated, resulting in brighter and more active responses to intellectual instruction.

The successful results in plant stimulation seem to accompany the presence of a high-tension field, either direct or alternating in character. In Mr. Gloede's experiments one terminal of the source was buried in the ground under the plants, the other being connected to an overhead network. A transformer was used to furnish the high voltage. In the recent English experiments a static influence machine was utilized and even higher voltages applied. The latter would seem to be the more economical method of applica-

tion since the principal power consumption is due to leakage. The direct losses are the friction of the moving apparatus and the losses in the driving motor. These are undoubtedly less than the losses entailed in Mr. Gloede's frequency changer and transformer, which are stated to consume several horsepower.

In connection with the stimulation of growth by electricity, it is of interest to consider that both animal and vegetable organisms are able to generate electricity. Such generation probably goes on to some extent in all living bodies, but it is only in exceptional cases that the magnitude is sufficient to be noticeable, except with the aid of delicate measuring instruments. Thus it has been shown that static charges occur upon different portions of the human body, occasioned by muscular contraction or otherwise. Activity of the nerves and muscles gives rise to electric currents. It is considered that such results are due to electromotive forces generated in a manner similar to that which obtains in the form of primary battery known as a concentration cell. This consists of two electrodes of the same metal in a solution of the same salt, which has different concentrations at the two electrodes.

The electric eel and several other animals able to give powerful shocks are well known in the literature of the subject. The organs which perform this function are in construction similar to a condenser. A Brazilian plant, known as *Phytolacca electrica*, has recently been discovered, which also is capable of producing a difference of potential exceeding one volt.

ARMORING THE LEADS TO COOKING APPARATUS.

The necessity of good insulation, which applies to all electric apparatus and especially to such as is concerned with static electricity, is nowhere more important than in the devices which are to be used by the non-technical public. The shock, or the blaze of a short-circuit, which makes slight impression upon the electrician or engineer, often works as a powerful deterrent upon the lay user of electric appliances, and a single experience of that kind may produce a lasting prejudice against the use of electric household devices. No precaution should be omitted, in the design and construction of such apparatus, to make such unpleasant experiences impossible.

This consideration is especially important in connection with cooking and other heating devices. The leads and connections to such appliances are especially liable to be subjected to high temperatures, moisture, dirt, etc., and most insulating materials are easily injured by grease, heat and water. Frequent bending of a lead wire or cord will often start mechanical breaks, especially in rubber which has aged considerably. Where an excess of cord is provided, this may easily get in the way and may be burned by coming in contact with heated members, as, for instance, if a hot iron be carelessly laid upon it.

To prevent shocks, it is desirable that metal parts of stationary apparatus, such as an electric range, be grounded. To prevent damage to insulation, with resulting short-circuits or shocks, it is desirable to use cord connections having a flexible metal sheathing, and where it can be easily done, this should be grounded also. There can then be little possibility of trouble arising of such a nature as to startle or injure the person handling the apparatus.

With precautions of this kind there is no objection to the use of 240 volts, or even higher. While general American practice is to wire houses for 110 or 120 volts, it is quite customary to bring all three leads of a three-wire system into the premises, and very slight changes in the wiring would make the higher voltage available in the kitchen. The advantage of this lies in making the current consumption smaller, and rendering a circuit originally installed for lighting available for a cooking load. In some cases this would avoid the necessity of running a separate circuit expressly for that purpose.

TELEPHONE PIONEERS OF AMERICA.

On other pages of this issue will be found a report of the proceedings of the first meeting of the Telephone Pioneers of America. To be eligible for membership in this organization the candidate must have been in the telephone business at least twenty-one years ago and for a period of not less than five years. The Society has among its members some whose connection with the industry dates back thirty-five to forty years, and there are a number who were actively engaged in developing the telephone over thirty years ago. So far as the span of time is concerned this is not a great distance back, but so far as the telephone industry is concerned it reaches into pioneer days indeed.

The introduction of the telephone was beset with more than ordinary difficulties. The commercial world forty years ago was highly skeptical concerning an invention of this character, and the commonplace acceptance of scientific marvels of today was entirely lacking at that time. Thirty-five years ago the telephone was contemptuously refused as incompatible with the dignity of the business office. Today it is depended upon in every phase of industry as the most essential and most dependable element of the mechanism of business.

To Boston and the men of brains and courage of the New England States much of the credit for the introduction of the telephone must be given, although as a matter of historic truth the conception of the telephone and Bell's pioneer work were done largely in Canada. It is fitting that the first meeting of the Telephone Pioneers of America should be held in that city. It was from Boston to Cambridge that the first two-sided telephone conversation was held, and Boston men and Boston capital backed the scientific toy and pointed the way for the wonderful accomplishments that we are blessed with today.

ELECTRICITY AND POLITICS.

In the early history of this country, republican government soon resolved itself into government by party. It is true that in the first federal election the personality of George Washington dominated all else, but before many years the voters of the country found themselves naturally segregating into two groups, the Federalists and the Democratic Republicans (later the Democratic party). Under the conditions then existing, it was only through party organization that principles could be espoused. Communication and travel inland were difficult, and knowledge of events and of persons penetrated but slowly throughout the country. The people could act effectively only through leaders, and the leaders were expected to carry out the genral policies for which the party stood. With the settlement of the territory west of the Alleghany Mountains, distances became even greater, and general communication correspondingly difficult.

The party solidarity thus engendered became habitual with the people and grew into a fetish. The party name was a thing to rally about, a thing by which the leaders might blindly lead the people. Under the stress of unusual circumstances, new parties were occasionally formed, parties of reform. Some of these passed into oblivion without accomplishment; some, like the Republican party, achieved success, and became, in turn, a possession to be passed on religiously to the next generation.

In the meantime a new condition had been coming into being. The advent of the telegraph and the telephone enabled news to be quickly disseminated, and the railroad made transportation swift and safe through the use of the telegraph and the block signal. What occurs in one place today is known all over the country tomorrow. People are in touch with events; events become known not as history, but as current life. Public opinion is alive, it is concerned with the questions of the hour. People are no longer willing to merely write their desires in party platforms, but they are clamoring for direct nominations and direct legislation. And these are coming, slowly perhaps, but nevertheless surely.

The invisible walls of political parties, more rigid and unyielding than walls of stone, are at last crumbling. Party loyalty beyond the point where the party ceases to represent the ideas and the ideals of the individual is no longer a virtue, except among those who cling to the old traditions. It is the independent vote which decides most of our elections, the partizans in neither class numbering a majority. It has taken a generation of daily contact with the world of action to bring this new attitude, but at last it has come. The possibility of party domination has rested upon the inertia of public opinion, and that inertia has decreased in direct proportion to the speed of propagation of knowledge, and the habit of quick assimilation of it. One may now change one's mind between elections, and it is no longer a disgrace to scratch the party ticket. Indeed we may yet see the time when party designations will not appear on the ballot, as is already the case in some municipal elections.

This development of the political independence of the individual, and the decadence of the political domination of the party and the party leader, can be largely attributed to the modern facilities for communication, including the rapid distribution of the popular magazine. The great agency behind it all, the agency which has done more than aught else to accelerate modern civilization, is the subtle power of the electric current. When that great statesman and political leader of Revolutionary times, Benjamin Franklin, contributed his experiments towards the world's knowledge of the electric form of energy, little did he realize that his work would have an influence upon the political conditions of his country in the twentieth century.

BREAKDOWNS OF ELECTRIC MACHINERY.

Upon another page will be found the report of Mr. Michael Longridge on the electrical breakdowns in England during the past year. Mr. Longridge is chief engineer of the British Engine, Boiler and Electrical Insurance Company, and the report covers inspections made upon cases of breakdown in which the Company was interested. The report is consequently not to be regarded as a complete report covering all breakdowns in that country, but is of interest in comparison with the similar data collected by the company in other years, and in showing the proportions of breakdowns due to different causes, which may be taken as typical of the entire industry.

The report shows an increase in the percentage of breakdowns of generators, and alternators appear to fail more frequently than direct-current machines, in a ratio of more than three to one. This is very likely due to the higher voltages prevalent in alternating-current machines. Motors, switches and controllers, on the other hand, show an improvement over previous years, although this is not marked.

The causes of breakdown exhibit a decided increase in the percentage due to depreciation through age, with a decrease in the number due to negligence and causes not ascertained, which more than neutralizes the first; hence the total is not increased. The cost of breakdowns, however, shows a greater increase than the number of machines insured.

In a portion of the report which we have not published, interesting particulars are given of tests carried out on various types of plant. The experience in this field indicates that there is little difference in fuel consumption in plants of about 1,000 kilowatts between electric drive supplied from a turbo-generator and rope drive with a reciprocating steam engine. Electric drive requires a larger initial investment and thus involves greater fixed charges, but has compensating advantages in the use of less oil and other supplies and in occupying less floor space.

Electrical Contractors' Association of Texas.

At a meeting of electrical contractors from different parts of the state held at Dallas, Tex., October 27, the Electrical Contractors' Association of Texas was organized.

Officers were elected as follows: president, Martin Wright of San Antonio; vice-president, A. E. Hancock of Austin; secretary, E. H. Johnson of Dallas; treasurer, H. E. Wells of Dallas.

The Association is made up of the several local organizations in Texas, the eight represented having seventy-five members. Officers and a representative selected from each of the locals will form the Executive Committee. The president will appoint the other committees, except the Legislative Committee, which was selected as follows: H. L. Hancock of Dallas, Eugene Ashe of Fort Worth and F. H. Schroeder of Austin.

It was decided that the semi-annual meetings shall be held at the time of the convocation of the Rejuvenated Sons of Jove in the fall and of the Gas and Electrical Association in the spring.

Among the delegates present were Martin Wright, San Antonio; D. H. Murphy, Dallas; W. N. Dilzell, Houston; J. A. Butler, Dallas; F. H. Schroeder, Austin; Eugene Ashe, Fort Worth; H. E. Wells, Dallas; S. P. Spears, Paris; J. J. Owen, Waco; E. H. Johnson, George H. Egan, W. Albright, W. M. Clower, C. M. Cockrell, Gus French and others of Dallas.

Milwaukee Electric Railway & Light Company Reorganizes.

A reorganization plan under which the business of the Milwaukee Electric Railway & Light Company and its associated and controlled companies will be conducted more systematically, and by which James D. Mortimer, the general manager, will be relieved from considerable detail work, went into effect November 1.

Under the new order the general manager will deal directly with only three men: R. B. Stearns and S. B. Way, assistant general managers, and C. N. Duffy, comptroller.

The departments will be organized as follows, the three officials being responsible for the departments as shown: R. B. Stearns, way department, building department and drafting bureau shops department, transportation department and claim department; S. B. Way, power-plant department, electrical department, sales department, also the following companies, the managers of which will report directly to Mr. Way: Milwaukee Central Heating Company, Racine Gas Light Company, Kenosha Gas & Electric Company, Watertown Gas & Electric Company, North Milwaukee Light & Power Company; C. N. Duffy, accounting department, purchasing and stores department, printing department, advertising and publicity department.

Egbert Douglas, having resigned as commercial engineer, takes charge of the sales departments and T. D. Crocker, retaining his position as general superintendent of Milwaukee Central Heating Company, has been appointed commercial engineer.

Meeting of Electrical Credit Association.

The sixteenth annual meeting of the Electrical Credit Association of Chicago is to be held on November 16, at the Chicago Athletic Association. The business meeting will be called to order promptly at 2:00 p. m., and after the reports of officers and committees and the election of officers, the following papers will be presented: "Disputed Accounts and the Executive Committee," A. O. Kuehmsted; "Keeping Faith," W. A. Brady, Commercial Electrical Supply Co.; "Reporting Municipalities," by E. E. Ingels, B-R Electric & Telephone Manufacturing Co.; "Forms and Model Letters," F. D. VanWinkle, Post-Glover Electric Company; "Does the Association Pay?" S. E. Kennedy, Central Electric Company; "Contractors as Credit Risks," E. R. Gilmore, Western Electric Company; "The Credit and Sales Departments," George C. Steele, North Electric Company.

At 6:30 p. m. the annual dinner will be served, accompanied by singing which will be lead by H. H. Cudmore of Cleveland, O. The toastmaster will be A. A. Gray, who will introduce the following speakers:

William J. Hagenah, "Regulation of Public Utilities."

Julius R. Kline, "The Measure of a Man."

Harry A. Parkin, "The Sherman Act in Business."

Harry A. Antrim, "Hoosier Harpings."

Electrical League of Cleveland.

The Electrical League of Cleveland inaugurated the third year of its existence by a noon dinner in the banqueting hall of the Gillsy Hotel on Friday, November 3. The room was literally filled to overflowing by 163 members and guests, and this large attendance is thought to forecast a year of greatly increased influence and usefulness for the League among Cleveland electrical men. Homer E. Niesz, president of the Chicago Electric Club, was introduced by H. H. Cudmore, president of the Cleveland organization, and spoke forcibly on the benefits of co-operation in the electrical industry, referring specifically to the newspaper "Electrical Page" movement, which received its first stimulus in Cleveland, and is now being investigated by a committee of the Chicago Electric Club with a view to the desirability of recommending that such a page be started in one of the large dailies of that city. In closing his speech, Mr. Niesz congratulated the League on its spirit of harmony and enthusiasm, and on the attendance which, he said, would be considered large even by the Electric Club of Chicago.

Meetings of the Electrical League of Cleveland will be held fortnightly throughout the winter and spring. T. P. Cagwin is secretary.

Central Electric Railway Association.

The program for the last regular meeting of the Central Electric Railway Association for 1911, to be held in the Galet House, Louisville, Ky., November 23, is now being prepared by A. L. Neereamer, secretary of the Association.

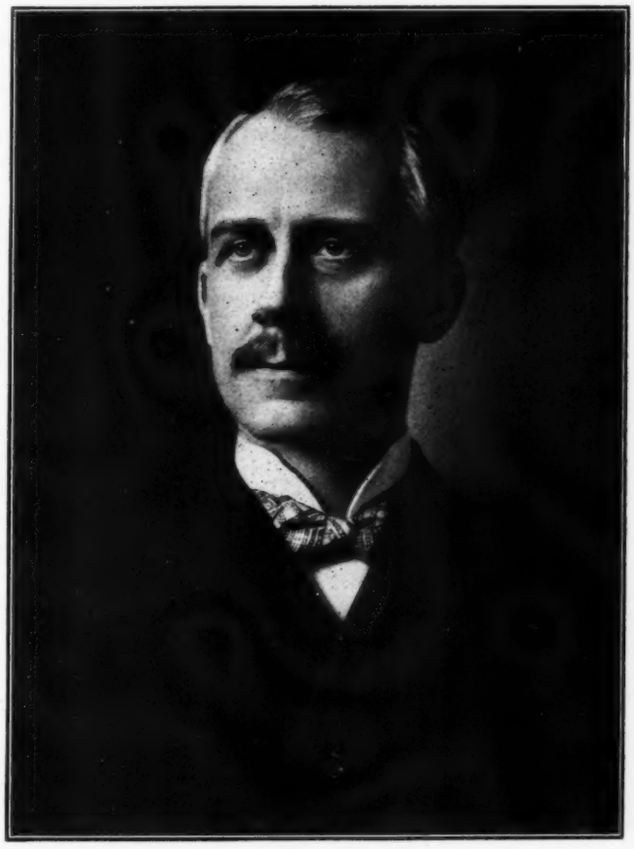
The program will include papers on "Publicity," by J. J. Rockwell; "Traffic," by Frank D. Norveil; "Electric Locomotive Interurban Freight Haulage," by F. E. Wynne; "Lightning Protection," by E. J. Burdick, and "Substation Operation," by J. E. Cochran.

This will be the first time the Association has ever selected Louisville as a meeting point. Special trains will be run from several points in Indiana to Louisville for the occasion. It is expected that at least 200 interurban men will attend. E. B. Peck of Indianapolis, president of the Association, is urging traction officials to arrange to have as many of their employes attend the meeting as possible.

George H. Harries.

The story of the electric railway is one of practically constant evolution during the past quarter of a century, and the measures which have been necessary to bring an enterprise of this character to a successful issue have required ability of a very uncommon order. The comprehensive knowledge of operating characteristics, a close familiarity with the finesse of financing, and a thorough understanding of executive direction are essential. One of the most successful electric-railway men of the present day is George H. Harries, who has recently joined the engineering firm of H. M. Byllesby & Company, of Chicago, Ill. He has been made president of the Louisville Lighting Company, in Louisville, Ky., one of the Byllesby companies, and will devote his energies to the upbuilding of that property.

General Harries was born in Wales, in 1860, where he received his early education. When quite young he emigrated to the Canadian Northwest, spending a number of years on the plains and in the mining regions. Because of his familiarity with the traits of the Indians he was appointed a member of the Sioux Commission by President Harrison in 1891. Prior to the war with Spain, Mr. Harries was commissioned by President McKinley to the command of the Brigade of the National Guard at Washington, D. C., and during the war served as colonel of the First District of Columbia, United States Volunteers.



GEORGE H. HARRIES,
President of the Louisville Lighting Company.

General Harries had for a long time been a student of electric-railway and other public-utility affairs, and in 1896 was made president of the Metropolitan Railroad Company, of Washington, D. C. His connection prior to that time with the daily newspapers of the capital city had placed him in close touch with the existing problems of street-railway traffic, and he was very familiar with the experiments of the Metropolitan Railroad in its work with storage-battery cars. During 1898 and 1899 he served as a member of the Board of Directors of the Washington Railway and Electric Company. This company was the pioneer in the movement to consolidate many of the power and light companies of the district, and General Harries became vice-president of the company in June, 1900. He continued in this position through the receivership and change of name, until he resigned to become connected with the Byllesby organization.

General Harries is an earnest civic worker, and in 1898 and 1899 was secretary of the Washington Board of Trade, and later vice-president of the organization. He has for a long time been a prominent figure at national electrical conventions. He is president of the Association of Edison Illuminating Companies; treasurer and a member of the Executive Committee of the National Electric Light Association, and first vice-president of the American Electric Railway Association. He is a member of the Illuminating Engineering Society, the Washington Society of Engineers, the Washington Academy of Sciences, and an associate of the American Institute of Electrical Engineers.

Effect of Moving an Electrode in the Electrolyte.

A recent article by Pionchon in *L'Industrie Electrique* describes some experiments in which the change in the electromotive force due to the motion of the electrode in the electrolytic solution is measured. The method of measurement was to balance the electromotive force on a potentiometer. If after obtaining a balance the electrode was moved, it was evident that the balance was broken, indicating a change in the electromotive force.

In order to get accurate measurements of the phenomenon the electrodes were surrounded with porous cups and it was arranged to vibrate one of them by means of an electrically driven tuning fork. In this way the electromotive force of the moving electrode was sufficiently constant to permit of measurement. The effect was found to exist with all metals in all electrolytes which were tried, but there were differences in the direction and the amount of the effect. When zinc was moved in a solution of zinc sulphate, forming a positive electrode of the cell, the electromotive force was increased. When it formed a negative electrode the electromotive force was decreased. When two similar electrodes are used in the same solution so that there is no electromotive force when it is at rest, an electromotive force is produced by the motion of one electrode, which thereby becomes positive. In a Daniel cell the electromotive force increases when the positive electrode is moved and decreases when the negative electrode is moved.

The amount of the change with zinc in zinc sulphate is 0.025 volt, while with copper in copper sulphate it is only 0.005 volt.

Chicago's Automatic Telephone.

The Illinois Tunnel Company, which operates the automatic telephone system in Chicago, reports that during September it secured 1,000 new subscribers. The October increase was fifty per cent better.

Committee on Regulation of Utilities Meets.

The Executive Committee of the Department on Regulation of Interstate and Municipal Utilities met in New York October 25 to organize and prepare for making an exhaustive investigation of the problems involved in the questions of rates, franchises, the regulation of public utilities and the comparative merits of public and private ownership. Emerson McMillin, chairman of the Executive Committee of the American Light & Traction Company, was made chairman, and Prof. John H. Gray, head of the political economy department of the University of Minnesota, was appointed secretary.

Other members of the Executive Committee attending the meeting were: Franklin K. Lane, member of the Interstate Commerce Commission; Martin S. Decker, former president of the National Association of State Railway Commissioners; Milo R. Maltbie, member of the Public Service Commission of New York; Franklin Q. Brown, of Redmont & Company, railway director; Blewett Lee, counsel for the Illinois Central Railroad; P. H. Morrissey, former president of the Brotherhood of Railroad Trainmen; Leo S. Rowe, professor of political economy, University of Pennsylvania.

The work of the department was divided among sub-committees, of which the following are chairmen: Committee on Rates, Franklin K. Lane; Committee on Control of Service, Martin S. Decker; Committee on Control of Capitalization, Milo R. Maltbie; Committee on Franchises, Blewett Lee; Committee on Accounts and Feports, Leo S. Rowe; Committee on Draft of a Model Bill, John H. Gray.

Initial Chicago Subway Report.

The subway commission, comprising John Ericson, J. J. Reynolds and E. C. Shankland, which Mayor Harrison appointed some time ago to study the transportation system in Chicago with a view to recommending feasible plans for a subway, made its initial report on October 31.

The preliminary plan is in effect the joining of the South Side Elevated Railroad with the Chicago & Oak Park Elevated in the "south-northwest subway," and the joining of the Northwestern with the Metropolitan Elevated in the "north-southwest subway."

The plan creates a total of 3.857 miles of tunnel, with estimated cost of construction, protection and allowance of $9,812,000. The report also includes plans for subways for through-route surface cars from the south to the northwest side, and from the north to the southwest, creating 3.892 miles of tunnel at a cost of $9,328,000.

The commission declares the project is a sane and feasible construction, with a high level easily accessible, and easily ventilated; it allows through routing; it has no grade crossings, no switches, no turnouts, few curves, and easy grades; a minimum of private property required; cost within limitations and lowest consistent with safety, and is capable of almost unlimited expansion.

International Competition in Telegraphy.

In connection with the International Exposition at Turin, Italy, there was held an international competition in practical telegraphy, open to members of the Telegraph Union in all parts of the world. There were 226 competitors, of whom 112 were foreigners.

There were no entries from the United States in any of the competitions.

In the trial with Morse apparatus there were 117 competitors, the principal prizes being won by Messrs. Schinetti and Padroni of Italy.

In the test with the Hughes apparatus the winners were Messrs. Martens of Belgium, and Zillig of Germany. In the test with Baudot apparatus there were eighty competitors, the main awards going to two Frenchmen, Messrs. Chapius and Maurel.

The winner of the prize with the Hughes apparatus, Martens, succeeded in transmitting in one hour without error a total of 1,502 words, involving 12,767 characters or signals.

Electrification in England.

The announcement that the North Eastern Railway is contemplating the use of the electrical locomotives for operating freight trains and also for switching purposes is a noteworthy indication of the progress which is being made by electric traction in England. Vincent Raven, the North Eastern Company's chief mechanical engineer, and C. H. Merz, the Company's consulting electrical engineer, are, with other members of the staff, now in the United States in order to observe the systems in vogue for operating freight traffic by electric power and to inspect the different types of electric locomotives used in America.

The Manufacture of Steel.

At the November 8 meeting of the Chicago Electric Club, C. G. Osborne, metallurgical engineer of the Illinois Steel Company, interestingly described the various methods of manufacturing steel. There are four commercial processes in use and Mr. Osborne briefly recounted the underlying principles of each process. The electric-furnace process is the most recent and Mr. Osborne predicted that it is destined to be the most important.

There are three elective furnaces in operation at the South Chicago works. The process is really the open-hearth process in which the product from the Bessemer furnace is mixed with lime and then poured into the electric-furnace converter. The slag which forms on top of the charge is removed and a purifying slag of lime and coke dust added. Heat in the electric furnace is obtained from the arcs of three electrodes which are placed through the roof of the furnace. The electrodes are twenty-four inches in diameter and six feet long. The energy is alternating current, twenty-five cycles, fifty-five volts. Mr. Osborne explained that some heat is obtained from the resistance due to the electric current passing through the bath in the furnace. However, the hot spots caused by the arcs is a detriment to the electric furnace.

Mr. Osborne briefly described the process of handling the steel from the iron-ore charge to the finished product. In conclusion, he invited members of the Club to visit the steel works at South Chicago.

Before the address of Mr. Osborne, President Neisz spoke of his visit to Cleveland and his address before the Electrical League of Cleveland on November 3. He commented on the large attendance at the Cleveland meetings, which he thought was due to the practice of the club in telephoning members before meetings. It was decided to give this scheme a trial in Chicago in an effort to increase the weekly attendance.

The largest turbo-alternators yet built or begun in Europe have an output of 20,000 kilowatts.

NEW YORK EDISON COMPANY STARTS UP LARGEST GENERATING UNIT IN THE WORLD.

BIG VERTICAL TURBINE WITH NORMAL RATING OF 30,000 HORSEPOWER PUT INTO SUCCESSFUL OPERATION AT THE WATERSIDE STATION.

On Friday, November 3, the most powerful generating unit in the world was placed in operation at the Water-

20,000-KILOWATT TURBOGENERATOR AT WATERSIDE STATION NO. 1, NEW YORK CITY.

side station of the New York Edison Company. George B. Cortelyou, president of the Consolidated Gas Company, of New York, officiated.

The big generator took on the load of seven of the 3,500-kilowatt vertical reciprocating engines and generators one after the other as they were shut down, operating perfectly and carrying the load continuously without distress.

The turbine is of the vertical type, manufactured by the General Electric Company, and the base dimensions are seventeen feet, six inches by seventeen feet. The height above the floor is thirty-five feet, seven inches. The height of the foundation above the basement floor is ten feet. The area occupied is 297 square feet. The generator is of the four-pole, three-phase, twenty-five-cycle type, operating at 6,600 volts, 750 revolutions per minute. The steam-consumption guarantees, at 175 pounds gauge steam pressure, 28.5-inch vacuum, 100 degrees superheat, are as follows:

Load in Kilowatts.	Steam, Pounds per Kilowatt-Hour.	Total Steam per Hour, Pounds.
10,000	15	150,000
15,000	14.4	216,000
20,000	15	300,000

The weight of each machine is 420 tons; the weight of revolving parts 112 tons; the weight of the heaviest part 110 tons; the diameter of the wheels thirteen feet; the total number of wheel buckets 7,200, and the bucket velocity approximately six miles per minute.

The turbine has a capacity of 20,000 kilowatts with a nominal rating of 30,000 horsepower. Three of these 20,000-kilowatt turbines occupy a space formerly taken up by four of the old 3,500-kilowatt engine-driven units, which a few years ago were considered as representative of the highest development in engine and generator design.

The turbines will use 7,200,000 pounds of steam per day, which at an evaporation of nine pounds of water per pound of coal will mean that for each turbine 400 tons of coal must be burned every day. For condensing, 86,000,000 gallons of water are required per day. Each unit requires 80,000 cubic feet of air per minute for cooling the generator windings.

The main generating or Waterside Stations of the New York Edison Company occupy two city blocks and have a capacity of 500,000 horsepower. At the present time there are 1,114 miles of

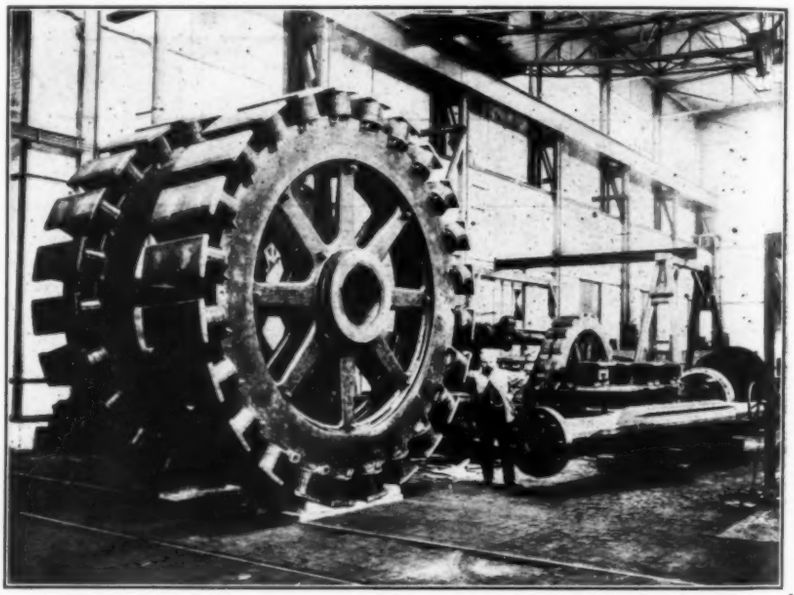
mains, feeders and cables in the underground system. Energy is supplied to practically the entire island of Manhattan with a little over twenty-one square miles, and the Borough of the Bronx with approximately forty square miles. The company's system supplies over 100,000 customers through 122,000 meters. The installations aggregate 4,341,000 incandescent lamps, 40,200 arc lamps, and 263,500 horsepower in motors. On December 31, 1910, the aggregate of these was 572,000 horsepower. The system includes also thirty-one annex stations, a half-dozen district offices, a library, two schools, laboratories and a number of store rooms. The company operates 100 electric vehicles for its emergency, repair and light delivery service.

Large Generators for a Norwegian Hydroelectric Plant.

The five polyphase generators of 17,000-kilovolt-amperes capacity recently furnished to the station at Rjukanfos, in Norway, are probably the largest three-phase machines which have yet been built in Europe. They were built by Brown, Boveri & Company. They have direct-connected exciters which furnish 130 kilowatts at 220 volts. Each of these generators runs at a speed of 250 revolutions per minute; requires 14,450 horsepower and with a power-factor of 0.6 and a voltage of 10,000 to 11,000 volts delivers three-phase current at fifty cycles to the value of 17,000 kilovolt-amperes. They are driven by direct-connected hydraulic turbines and serve to supply an electrochemical factory for the fixation of atmospheric nitrogen. They are consequently subjected to heavy variations in load and large short-circuits. Four of these generators are run in pairs on common shafts. Between the two stators there is a fireproof wall so that in case of a fire breaking out in one winding its spread to the other machine is prevented.

The guaranteed efficiency including all losses due to ventilation and friction is 94.8 per cent for the pair of generators and 95.3 per cent for a single generator under full load and with a power-factor of 0.6. The change in voltage produced by a sudden change in load from zero to full load is 3,800 volts and by the reverse change 2,400 volts. The total weight of one generator is 205,000 kilograms, of which the rotating field with its shaft constitute 92,000, and the stator about 90,000 kilograms.

The stator consists of a large casting in which the active iron is fastened by dovetailed springs, and is held together by means of strong plates which reach out to the teeth so that a positive and noiseless drive can be expected. For ease in making repairs the stators can be shifted in the direction of the axis. The outer diameter of the stators is about six meters, the inner diameter 4.4 meters, and the height of the iron core is 21.5 centimeters. The machines have been constructed with a complete ventilating circuit and are provided with openings which permit a part of the warm air being expelled into the engine room for the purpose of heating it.



REVOLVING FIELDS OF THREE-PHASE GENERATOR FOR RJUKANFOS.

The arms and hub of the rotor field consist of cast steel, while the circumference is built of rings of forged steel. The cast-iron poles have laminated pole shoes and are held in the rings by means of mortised joints and fastened by means of suitable wedges. The winding for the poles consists of hard-rolled copper. All of the pole windings are connected in series and receive their current through slip rings of steel with which carbon brushes make contact. Each rotor was tested in the shop at a speed of 450 revolutions per minute for a half hour. This is 1.8 times the normal speed and would have brought out any defect which might appear in the operation with a turbine.

The bearings are of ample dimensions and are provided with lubrication under pressure. They are, in addition, provided with oil rings and water cooling so that in case of any breakdown in the supply of oil under pressure it would be possible to continue operation.

Special Rates for Independent Telephone Toll Lines to Chicago.

At the call of the Illinois Tunnel Company a conference was held in Chicago on November 4 between officials of this company's telephone department and a large number of managers of independent telephone companies operating in Illinois, Indiana and Iowa. The men were entertained at a luncheon given by C. O. Frisbie, president of the Illinois Tunnel Company, and were shown through several of the new automatic exchanges of the company. They were impressed with the scope of the undertaking and with the earnestness of the company to extend its long-distance connections around Chicago.

Regarding the subject of toll rates it was agreed to adopt what are practically the Bell system rates for day service, except that the first charge covers a conversation of five minutes instead of three; a special night rate of sixty per cent of the day rate applies to calls made between 6 p. m. and 7 a. m. It was believed that both these features would greatly stimulate the long-distance traffic to and from Chicago over all available independent lines. Efforts are to be more actively made to extend the service in all directions and to standardize the equipment.

TELEPHONE PIONEERS OF AMERICA.

FIRST REUNION HELD AT BOSTON, MASS., LAST WEEK, AND A PERMANENT ORGANIZATION EFFECTED.

The Association of Telephone Pioneers of America was formed in Boston on Thursday of last week, at the Hotel Somerset. The idea of this Association originated with Henry W. Pope, Charles R. Truex and Thomas B. Doolittle, all three of these gentlemen having been identified with the early days of the great Bell invention. There were about 250 in the convention hall at the Hotel Somerset, when the assembly was called to order by Mr. Doolittle. Gen. Thomas Sherwin, chairman of the Board of Directors of the New England Telephone & Telegraph Company, was elected temporary chairman, and H. W. Pope temporary secretary. General Sherwin delivered an address of welcome, following which the following permanent officers were elected:

President:—Theodore N. Vail, Boston.

Vice-Presidents:—Frank H. Bethell, New York; W. T. Gentry, Atlanta, Ga.; B. E. Sunny, Chicago; E. B. Field, Denver.

Secretary and Treasurer:—Henry W. Pope, New York.

Executive Committee:—Thomas D. Lockwood, Boston; John J. Carty, New York; Francis A. Houston, Boston. Two additional members of the executive committee are to be appointed. Mr. Gentry presided during the sessions.

The dues of the Association are $5 annually, and the first gentleman to get his receipt was W. L. Candee, who is a telephone pioneer of the year 1877.

The constitution and by-laws of the Pioneers' Association were adopted, and also plans for annual meetings. All persons who served for five years consecutively in telephone work prior to 1891 are entitled to Pioneer membership in the Association, and Junior Pioneers are made up of those who will have served twenty-one years subsequent to 1891.

During the day addresses were delivered by Alexander Graham Bell, Frederick P. Fish and Thomas D. Lockwood. Professor Bell's address will be found elsewhere in this issue.

On Thursday evening the ladies and gentlemen of the Association were entertained at a theater party as the guests of the New England Telephone Company. On Friday forenoon they visited the main exchange of that company, and on Friday afternoon a very delightful automobile ride was enjoyed to Lexington and Concord. On Friday evening the visitors were tendered a highly enjoyable banquet by the American Telephone & Telegraph Company. Music and the singing of original songs with a telephone turn, written and rendered by Angus S. Hibbard, were participated in, and a magic lantern threw upon a screen many historical pictures relating to the telephone, and also the countenances of many of the men eminent in telephone work. These were received with much applause. Particularly was this the case when photographs of Theodore N. Vail, Edward J. Hall and John J. Carty were presented. Every attendant at the banquet received, with the compliments of the Western Electric Company, a model of Bell's first telephone, a very highly prized sonvenir.

A number of letters of regret were read, among them letters from Theodore N. Vail, B. E. Sunny, Frank B. Knight, C. E. Yost and George C. Maynard.

On Friday afternoon a photograph of all those who could be assembled was taken in front of the Hotel Somerset, and is reproduced on pages 970-971.

Among those present at the convention and banquet were the following: C. H. Wilson, F. A. Pickernell, H. L. Storke, M. Eglesten, Thomas D. Lockwood, J. J. Carty, C. E. Scribner, N. C. Kingsbury, Chas. W. Price, W. R. Abbott, J. N. Keller, A. S. Hibbard, F. P. Fish, Thomas Sherwin, W. R. Driver, C. F. Sise, Alexander G. Bell, H. B. Thayer, F. O. Vaille, Leland Hume, H.W. Pope, Thomas B. Doolittle, W. T. Gentry, A. L. Salt, H. F. Stevens, E. B. Baker, F. A. Houston, E. T. Holmes, C. J. Glidden, W. L. Candee, S. G. McMeen, R. T. McComas, H. G. McCulley, D. M. Adee, F. E. Kinsman, F. W. Harrington, George T. Manson, L. A. Madden, John J. Ghegan, C. A. Nicholson, C. W. McDaniels, Moses G. Parker, James Menzies, J. N. Culbertson, C. B. Burleigh, J. F. Canfield, Martin Joyce, A. H. Embler, C. B. Doolittle, F. P. Lewis, J. T. Moran, Thomas B. Bailey, V. M. Berthold, C. J. H. Woodbury, N. W. Lillie, F. J. Boynton, W. J. Denver, A. N. Bullens, T. J. Killian, W. J. Keenan, R. W. Devonshire, J. D. Ellsworth, George E. Betts, C. T. Keller, H. A. McCoy.

There were a number of historical exhibits shown at the Hotel Somerset, among them being the following, the exhibits being in charge of N. W. Lillie, who entered the telephone service October 8, 1877, and George K. Thompson, who entered the telephone service 30 years ago:

The original six-line switchboard used at the office of E. T. Holmes, 342 Washington Street, Boston, for connecting banks by telephone.

Magneto bells, battery bells, switches and types of apparatus used in the first days of the telephone business.

The first lists of subscribers issued in Boston, New York, Chicago, Newark, N. J., and other places.

Photographs of the building first used for a telephone exchange at 342 Washington Street, Boston, Mass., and of the building at 518 Broadway, New York.

Original circulars distributed in Boston and vicinity describing the uses for which the telephone was adapted.

Photographs of early telephone exchange interiors and many papers of interest.

Earliest New Haven, Conn., telephone directory.

Chinese exchange pictures, San Francisco.

Parts of Bell's original telephone of 1875.

Parts of Bell's Centennial iron-box telephone.

Single-pole membrane telephone.

Bell's figure-seven transmitters.

Bell's figure-seven receiver.

Bell's telephone receiver—early form.

First sample of hard-drawn copper wire.

Bell's receiver for educational purposes.

Fac-simile of Blake's original transmitter.

Blake's transmitter, first commercial form.

Blake's transmitter, final commercial form.

Cross-section model of standard bipolar receiver.

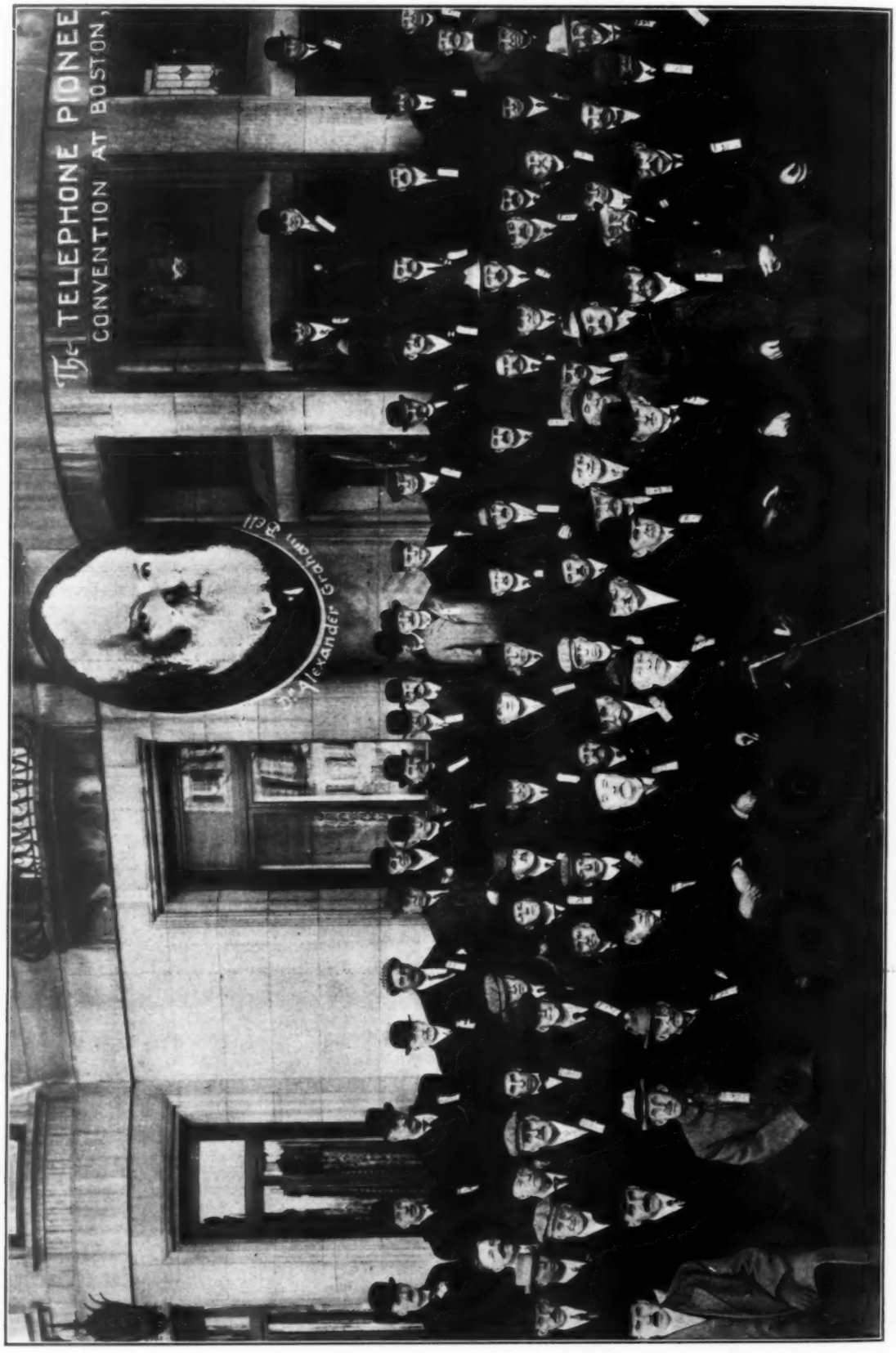
Cross-section model of solid-back transmitter.

Early form of telephone insulator bracket.

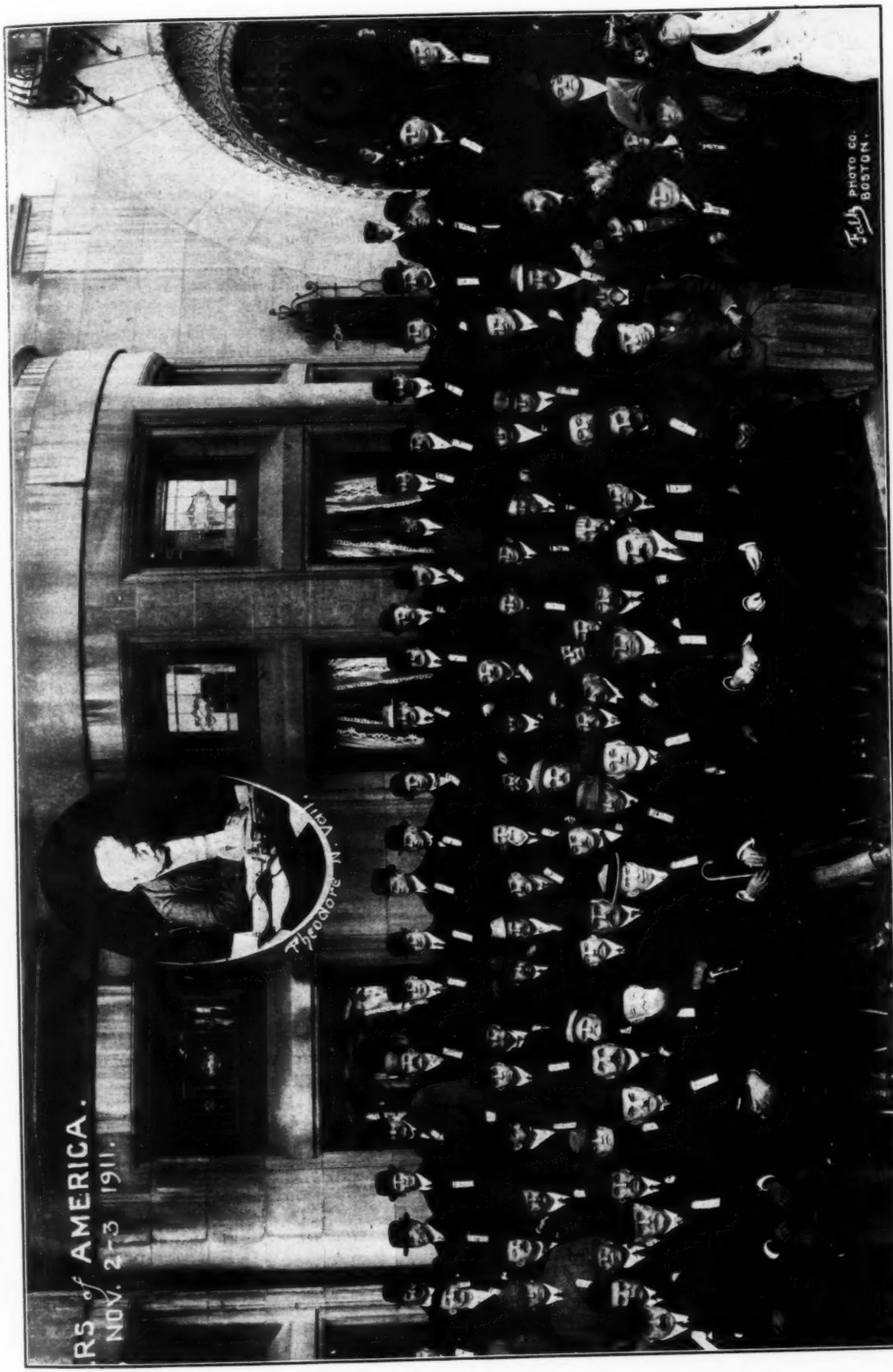
Telephone Despatch Company. List of subscribers, Boston and vicinity and many other lists of subscribers of early days.

Russian Telephone Service.

The telephone service in Russia is maintained partly by the Government and partly by private companies. The zemstvos are also exploiting the telephone service in sixty-nine counties. Last year the Government maintained ninety-nine urban telephones lines and four long-distance lines. Besides this a telephone service was carried on between thirty cities by means of telegraph lines. The receipts from the Government's telephone system amounted to $1,370,855, and the expenditures to $774,393, yielding a profit of $596,462. A telephone service was also maintained in fifty-five cities by private companies, and the Government's revenue, derived by means of a tax of three per cent levied upon the gross income of these companies, yielded $77,466.



LEFT HALF OF GROUP, TELEPHONE PIONEERS OF AMERICA.



RIGHT HALF OF GROUP, TELEPHONE PIONEERS OF AMERICA.

THE INVENTION OF THE TELEPHONE.

ADDRESS OF ALEXANDER GRAHAM BELL BEFORE THE TELEPHONE PIONEERS, GIVING EARLIEST FACTS NEVER BEFORE PUBLISHED—DELIVERED AT BOSTON, NOVEMBER 2, 1911.

Mr. Chairman and Gentlemen: This is a great day for me—the first meeting of the Telephone Pioneers of America and of the world. It gives me great pleasure to meet with you all today; and yet, there is a feeling of sadness about it. I am the first telephone pioneer, and my memory goes back to the very beginning; and I miss the faces I remember so well, the faces of the old pioneers, whom I wish were here today. The Association is fortunate that one of these old pioneers is at the head of matters today—Mr. Theodore N. Vail, that great organizing mind that presides over the destinies of the telephone system of America.

I feel it is a little presumptuous upon my part to try to speak of the telephone to telephone men. You have all gone so far beyond me! Why, the little telephone system that I look back upon—what is it compared to the mighty system that goes through the whole extent of our country today? It is to you that this great development is due, and I feel that it behooves me to speak very modestly of the little beginning that led to this great end. I can not tell you anything about the telephone. I can not speak to you about undulating current, intermittent current and pulsatory current. I belong to the past, you belong to the present; and it occurs to me that perhaps the most useful feature of my address today might be to call to your minds some of the notable events of the past that preceded the commercial organization and development of the telephone. This is a matter upon which I can give information; that is the point on which many of you may be weak. You know all about many of the later developments; you may not be so familiar with the earlier ones.

The period that marks the incipiency of the telephone was the years 1874 to 1877. It was in 1877 that the telephone really began its commercial career. I shall leave the time after that period to my friend Mr. Lockwood and shall deal chiefly with the points that preceded 1877. Of course, in dealing with this period of the history of the telephone I shall have to be somewhat personal, for it all centered upon me in those days.

From 1873 until the beginning of 1876 I was a resident of Salem, Massachusetts, and came into Boston every day for my professional work. Then I would spend my summer vacations in Canada, at Brantford, at the home of my parents. So these three places—Salem, Boston and Brantford—are concerned in the early days of the telephone. Boston is *par excellence* the home of the telephone, for it was here that all the apparatus was made and where the important experiments went on. Brantford, in Canada, was my thinking place, where I would go and spend my summer holidays and look over the line of experiments that had been made in Boston and plan for the future. I generally went to Brantford about the middle of July, stayed there during the summer and was back in Boston the first of October.

And so it happened that in the summer of 1874, during my visit to my father's house in Brantford, Ontario, considering myself and discussing with my father the numerous experiments I had made in Boston relative to the reproduction of musical sounds by electricity for the purposes of multiple telegraphy, the thought of the membrane telephone was elaborated. So that the conception of the telephone originated in Brantford, Ontario, in the summer of 1874. You are all familiar with it. It was practically the same instrument that was shown in the patent that is marked upon our little memento here. It was a theoretical conception of a magneto telephone, a very daring conception, if I may be allowed to say so—that the vibrations of the voice might create electrical impulses like the aerial impulses, and produce an audible result at the other end. To tell you the truth, as a practical man I did not quite believe it; as a theoretical man, I saw a speaking telephone, that theoretically we had the means of transmitting and reproducing speech in distant places. But it really seemed too good to be true that you could possibly create electrical impulses that would amount to any practical purpose by the action of the voice itself.

And so, on my return to Boston in October, 1874, and all through that winter and through the spring of 1875, instead of making the apparatus and trying it I was trying to devise methods of increasing the strength of these electrical undulations. I was working at what is now known as the variable resistance method. That is shown very well in a letter that I wrote to Mr. Hubbard on the fourth of May, 1875, when I was experimenting on the passage of a voltaic current through a vibrating wire, with the idea that the variation of tension in that wire, by producing variations in the resistance of the circuit, would produce the electrical undulations that I desired.

From the summer of 1874 up until June 2, 1875, the development of the telephone was delayed by this thought, that the magneto-electric impulses would not be sufficient by themselves and would require a battery current.

Then came the discovery, with which you are all probably familiar, that a magneto-electric current would produce by itself sonorous effects at a receiving station, and you may remember the plucking of reeds that went on that celebrated June 2, 1875. In a moment all the difficulties in the way of the practical solution of the telephone disappeared, and orders were given at once to construct the membrane telephone that was conceived in Brantford in 1874. When it was first tried it was somewhere about the end of June or July 1, 1875. We have present records of experiment on July 1, 1875, and I well remmember these experiments. We had only one membrane telephone, and the receiver was one of the old tuned reed receivers. It was held up to the ear. You crammed the armature against the ear to dampen its vibrations. I was listening at that armature while Thomas A. Watson, my assistant, was down in the basement of Charles Williams, Jr.'s, building, 109 Court Street, shouting at the end of the telephone, and then we changed places. I may say that I heard nothing. Then Mr. Watson went downstairs to listen, and I went upstairs to speak, and while I was speaking Mr. Watson came rushing up the stairs in a state of great excitement, saying, "Why, Mr. Bell, I heard your voice very distinctly, and could almost understand what you said." Well, that was gratifying, but it would have been still more gratifying if I could hear that, too. You see, Mr. Williams' workshop was a very noisy place. Mr. Watson was accustomed to that noise and could hear a good deal better than I. I was more accustomed to throwing out my voice than Mr. Watson, so that he had the advantage of me in hearing and I had the advantage of him in speaking. The results would be very unsatisfactory at the present time; yet, encouraged by the results, poor as they were, I went ahead immediately to prepare specifications for a patent. In September, 1875, I was at work upon the specifications of the now celebrated patent. In October, 1875, the patent was completed. But it was not filed in October, 1875. A long delay ensued, because I was so imbued with the idea of the value of this great invention that I was not satisfied to take out patents for America alone—I must take them out for every country on earth. But that, you know, required money, and I did not have the money. Mr. Saunders and Mr. Hubbard, who were associated with me and carried on my experiments, paid the cost of my experiments and of the American patent. They were too wise to touch foreign patents. So I had to go ahead and see what I could do to get this great patent taken up abroad, and that caused great delay. I went up to Canada to interview friends in Canada, and at last made an agreement with the Hon. George Brown, who was at one time Premier in Canada, that he and his brother, Gordon Brown, would take out patents in England and perhaps other countries, on one condition—that I should not file my application for an American patent until I had word from them that it would not interfere with the applications abroad. And so it was that the American patent dragged on for months, until at last Mr. Hubbard just said a quiet word to my solicitors in Boston: "It is no use waiting longer for Mr. Brown; just you put in the patent." And the patent was filed without my knowledge or consent. It is very fortunate that he did so. It saved a great deal of trouble and interference in the patent office, and so forth, and that is the patent on which the whole telephone system of the United States has been based.

I think it might be well to speak of a few of the more important points. The patent was filed February 14, 1876; it was allowed March 3, 1876. I was in Washington at the time when it was allowed. I know it was allowed on March 3, 1876, because that happened to be my birthday, and it came to me as a sort of birthday present.

After the granting of the patent came a period of publication, and I want to speak now of a very curious thing. In the case of new inventions we are generally led to believe that the public is ready to swallow anything, but that grave scientific men are the most skeptical of all. I found just exactly the opposite to be true in the case of the telephone. The public generally and the business men of the country were very slow to perceive any value in the telephone. The scientific world, on the other hand, took it up at once. My first paper upon the subject was delivered here in Boston before the American Society of Arts and Sciences on May 10, 1876. Then I was invited to lecture before the Society of Arts at the Institute of Technology, on May 25, 1876. Then came a very notable event, which I shall speak of very slightly, although it really forms the basis for the knowledge by the world of the telephone. It was the Centennial Exhibition, in 1876. Mr. Hubbard and Mr. Saunders, who were financially interested in the telephone, wanted this instrument to be exhibited at the Centennial Exhibition. In those days—and even up to the present time I am afraid it is true—I was not very much alive to commercial matters, not being a business man myself. I had a school for vocal physiology in Boston. I was right in the midst of examinations. My pupils, those studying under me, were studying to become teachers of the deaf, teaching speech to the deaf, and I could not be bothered at that time by having to go to Philadelphia and attend the exhibition. However, we found, in connection with the exhibition, that all the apparatus involving a necessity for quiet was to be examined on Sunday, June 25; and so it was urged that Sunday would interfere less with my professional pursuits than another day. I agreed, therefore, to go down and spend Sunday, and no longer.

I could not possibly stay any longer than that while in the midst of my examinations. So I went down to Philadelphia, growling all the time at this interruption to my professional work, and I appeared in Philadelphia on Sunday, the 25th. I was an unknown man and looked around upon the celebrities who were judges there, and trotted around after the judges at the exhibition while they examined this exhibit and that exhibit. My exhibit came last. Before they got to that it was announced that the judges were too tired to make any further examination that day and that the exhibit would be examined another day. That meant that the telephone would not be seen, for I was not going to come back another day. I was going right back to Boston.

And that was the way the matter stood—when suddenly there was one man among the judges who happened to remember me by sight. That was no less a person than His Majesty, Dom Pedro, the Emperor of Brazil. I had shown him what we had been doing in teaching speech to the deaf in Boston, had taken him around to the school for the deaf and showed him the means of teaching speech, and when he saw me there he remembered me and came over and shook hands and said: "Mr. Bell, how are the deaf mutes of Boston?" I said they were very well and told him that the next exhibit on the programme was my exhibit. "Come along," he said, and he took my arm and walked off with me—and, of course, where an Emperor led the way the other judges followed. And the telephone exhibit was saved!

Well, I can not tell very much about that exhibit, although it was the pivotal point on which the whole telephone turned in those days. If I had not had that exhibition there, it is very doubtful what the condition of the telephone would be today. But the Emperor of Brazil was the first one to bring that situation about, at that time. I went off to my transmitting instrument in another part of the building, and a little iron box receiver—you probably all know what it was from diagram—was placed at the ear of the Emperor. I told him to hold it to his ear, and then I heard afterwards what happened. I was not present at that end of the line. I went to the other end and was reciting "To be or not to be, that is the question," and so on, keeping up a continuous talk. I heard afterwards from my friend, William Hubbard, that the Emperor held it up in a very indifferent way to his ear, and then suddenly started and said: "My God! it speaks!" And he put it down; and then Sir William Thomson took it up, and one after another in the crowd took it up and listened. I was in another part of the building shouting away to the membrane telephone that was the transmitter. Suddenly I heard a noise of people stamping along very heavily, approaching, and there was Dom Pedro, rushing along at a very un-Emperorlike gait, followed by Sir William Thomson and a number of others, to see what I was doing at the other end. They were very much interested. But I had to go back to Boston and couldn't wait any longer. I went that very night.

Now, it so happened there, that although the judges had heard speech emitted by the steel disk armature of this receiving instrument, they were not quite convinced that it was electrically produced. Someone had whispered a suspicion that it was simply the case of the thread telegraph, the lovers' telegraph, as it was known in those days, and that the sound had been mechanically transmitted along the line from one instrument to the other. Of course, I did not know about it at that time; but when the judges asked permission to remove the apparatus from that location I said: "Certainly, do anything you like with it." But I could not remain to look after it; they had to look after it themselves. My friend, Mr. Hubbard, who had kindly come up from Boston to help me on this celebrated Sunday, the 25th of June, said he would do his best to help them out, although he was not an electrician. He knew nothing whatever about the apparatus, beyond being in my laboratory occasionally, knowing me well. But he undertook to remove this apparatus and set up the wire under the direction of the judges themselves. So they had an opportunity finally of satisfying themselves that speech had really been electrically reproduced. Sir William Thomson's announcement was made to the world in England, before the British Association, and the world believed, and from that time dates the popular interest in the telephone.

That was the 25th of June. Of course, the judges and others were anxious to know whether this thing would operate on a long line. Experiments had been made from one room to another in a building; but that was not quite as satisfactory as having one telephone in one place and another in another a hundred miles off. So I was asked whether I would venture to try the instrument between Boston and Philadelphia. Well, I, in my ignorance of the conditions, said: "Of course, yes." So when I went to Boston I began to consider: "Now, what are we going to do? These instruments are only prepared for short circuits." So we began to make experiments in Boston to fit the instrument for use on a longer line. I knew that we must have many turns of quite fine wire in the instrument; so I had such instruments constructed, and then the Atlantic & Pacific Telegraph Company in Boston kindly lent me the use of their wires for experiment. On July 7, July 9 and July 12, 1876, attempts were made to use the telephone upon various circuits from Boston to New York, from Boston to Rye Beach, and other places, but, unfortunately, with poor success. We did not get any vocal sounds on these circuits, although with two instruments, one in one room and another in another room of the Equitable Building and a circuit to Rye Beach, we did get some audible effect. But still the results were unsatisfactory where the undulating current was employed. We tried the intermittent current. I had a parlor organ, and made contact with New York and asked the operator to listen and see if he could hear anything. I played tunes on the parlor organ, and he was asked if he could hear anything, and he said, "Yes." "What is it?" "Yankee Doodle." He could hear tunes, but that was really the only result of importance obtained in those trials of July 7, 9 and 12, 1876.

Sir William Thomson was present at later trials, and I presented to him a telephone that we used on that occasion, and it was taken to England and bothered me exceedingly in telephone litigation at a subsequent time. The owners of my English patent had to disclaim everything that was shown in those instruments. But it fortunately happened that the receiving instrument was one of those old Centennial box receivers with a metallic lid, which in this case was one of ferro-type iron, and when I gave this instrument to Sir William Thomson I was afraid he would lose the armature; and so I had Mr. Watson catch the armature down at one point to the magnet, to hold it in place. Sir William just threw the whole thing in his trunk without taking it off, and when it arrived in England the armature, instead of being flat, was cocked up like that. Well, that saved the English patent. Everybody got the idea that the vibration was from this cocked-up thing. The English patent showed the cocking up of the armature. When it finally came before the Supreme Court of England, when they were deciding the case, the thing looked rather slim, according to the English law. The shreds of the patent were there—nothing was left but the metallic diaphragm. But they made a very singular construction. They said, according to a very benevolent construction of the law, as they construed it that did not interfere with the patent for metallic armature, and the patent was saved.

That brings me up to July 12, 1876. Then came my summer vacation of 1876. I went up to Brantford, Ontario. I prepared a whole lot of apparatus, telephones with coils of different kinds, high-resistance coils and low-resistance coils, long coils and short coils, and I carried them up with me to Brantford, Ontario, and continued attempts to get in touch with long-distance lines. The Dominion Telegraph Company of Canada kindly lent me the use of its wires, and I look upon one experiment there as of very great importance. It was an experiment made in August, 1876. The transmitting instrument was in Paris, Ontario; the receiving instrument, the Centennial iron-box receiver, was in Brantford, at a distance of eight miles from Paris; and the battery on the circuit was in Toronto, about sixty miles away. So we had a circuit of somewhere from sixty to seventy miles. The transmission went one way only, but speeches were transmitted, and that was the first time speeches were transmitted between persons at a distance of several miles. But it was only one way; the person at the other end could not reply, but had to telegraph back by another wire. But by August, 1876, quite a number of experiments that attracted attention were made on the wires of the Dominion Telegraph Company. There was one experiment between Brantford and Mt. Pleasant, a distance of about five miles, and then I gave an exhibition from my father's house at a country place, four or five miles from Brantford, known as Tutelo Heights. It was about a quarter of a mile from the house to the nearest telegraph line. We got a lot of stovepipe wire, cleaned the town out of stovepipe wire, and took the wire off the fence from my father's house to the corner of the Mt. Pleasant road, and then attached it to the telegraph wire leading into Brantford. Then I had some friends in Brantford who spoke, sung and recited into the membrane telephone, while a large number of guests at my father's house at Tutelo Heights listened to the transmission; and on that occasion also three voices were transmitted simultaneously. I had three mouthpieces made for the membrane telephone and three persons sang to the same telephone.

So those experiments at Brantford were the first experiments that were really successful in transmitting speech from one place to another at a distance, but they were all one-sided, not reciprocal.

The first reciprocal communication occurred after my return to Boston in October, 1876. On October 9 occurred the first conversation by telephone between persons separated by miles of space. This was on the Walworth Manufacturing Company's line, connecting its factory in Cambridgeport with the office in Boston. It was not a very long distance, probably two and one-half miles, but free communication was carried on, and I think that was an historical occasion. Mr. Watson was at one end of the line and I was at the other, and we kept a record of what passed. I noted what I said and I noted what I thought I heard him say, and the parallel columns were reported in the newspapers, especially in the Boston Advertiser, October 19. I think that was the first time that conversation had actually been carried on between two persons separated by miles of space. The space, however, was not great, only about two and one-half miles.

And so we went on during 1876 with experiments, trying to increase the distance at which results could be obtained. For that purpose the Cambridge Observatory offered its services. They had a private line from Cambridge to Boston for transmitting time signals from the Cambridge

Observatory, and through Professor Rogers I had the use of that line at night, when it was not needed for time purposes. I had it connected with my laboratory, and by night made experiments between the Cambridge Observatory and Boston, trying to ascertain the conditions fit for telephone service on long lines.

Then came a really noteworthy series of experiments on the lines belonging to the Eastern Railroad Company. An experiment was made on November 26, 1876, in which conversation was carried on between myself, in Boston, at the Eastern Railroad depot, and Thomas A. Watson, in Salem. We had increased the distance to eighteen miles. Then we experimented on a line that led to North Conway, 143 miles away, so that Salem was a way station to North Conway. That was a very notable extension. It was determined that we should send a man to North Conway, and Mr. Watson went up to North Conway with a stack of apparatus, with all sorts of modifications. Now that we had a chance of trying it out on a 143-mile circuit we were determined to take advantage of it, if we had to spend all day and night on it. All sorts of apparatus was carried. I was in Boston and he in North Conway. I think that was really the most important experiment that had been made in connection with the free commercial stage. This experiment was on December 3, 1875, when we had a free communication between Boston and North Conway.

Then we tried varying the coils, trying small wire, thick wire, long coils, short coils, tried it with and without a battery; and as a result of the experiments we gave up the battery and took to the magneto telephone alone, in the laboratory.

That takes us up to the end of 1876. There is hardly anything more I can tell you about it before it came into commercial use. On January 13, 1877, I gave a lecture on the subject at the Philosophical Society in Washington. On January 31, 1877, there was an experiment here in Boston that attracted a good deal of attention at the time, although it did not compare with the other experiments in importance. It was a communication between the rubber shoe factory and the residence of Mr. Converse in Malden, but it attracted a great deal of public attention to the telephone. On January 21 there was a public exhibition on the line of the Eastern Railroad, in which no battery was used. Conversation occurred between Boston and Salem; and by and by, at about that time, in the early part of 1877 or the end of the year 1876 a rather interesting circumstance took place. I had among my students at Boston University a young Japanese student named Tsawa. He came to me for the purpose of studying the pronunciation of English. Of course, when he heard about the telephone he became very much interested. He said: "Mr. Bell, will this thing talk Japanese?" I said: "Certainly, any language." He seemed very much astonished at that, and said he would like to try it. I said that he could try it, and he went to one end of the circuit and I stood at the other. He talked Japanese, and I reported the result to him. He asked if it talked Japanese. I said: "It talked Japanese, but I couldn't quite understand it." He was not quite satisfied with that, and asked permission to bring some Japanese friends of his from Harvard College. I said: "Certainly." He brought two young men there, and they talked through the telephone and listened; so that Japanese was the first foreign language that was spoken over the telephone. And these two Japanese, gentlemen, were exceptional men. I did not know who they were at the time, but years afterwards it was revealed to me. I was in Japan, in Yokohama, when the American residents in Japan were giving a banquet to the new Japanese minister who was going to Washington, Mr. Kamura, now at the head of affairs in Japan. I was asked to attend the banquet, and instead of being introduced to Mr. Kamura, he came up to me and said: "I don't require an introduction to Mr. Bell. I knew him years ago." And he turned out to be one of those Japanese students. Then I found out about the other one in a rather curious way. The Japanese government sent to this country at the time of the Russian-Japan War Baron Kaneko. He came to Washington and gave a lecture before the National Geographical Society. I happened to be president of that society at the time. And so, when the dinner was over and the time for the speaking came, Baron Kaneko said: "I knew Dr. Bell years ago," and he told his story about the use of the telephone. So those two men, the foremost men in Japan today—Baron Kaneko and Mr. Kamura—were the two men who heard the telephone in the winter of 1876-1877.

A few more words, and I shall have done. On February 12, 1877, I gave a lecture before the Essex Institute in Salem, Massachusetts, and the lines were connected with Boston. The speech was transmitted between Boston and Salem, and the audience generally could hear the sound of the speaker's voice, while those who came close to the telephone were able to converse with Mr. Watson in Boston. At the invitation of the Essex Institute this lecture was repeated on February 23, 1877, and admission was charged; and on this occasion the proceeds were presented to me for my lecture on the telephone. I immediately went into Boston and we had a little silver telephone made, and it is interesting now to look back upon the fact that that was made from the first money made from the telephone.

On that occasion a very interesting incident took place. A Boston *Globe* reporter had the brilliant idea that he would send a dispatch to his paper in Boston by telephone, and on that occasion the first newspaper dispatch ever sent by telephone was sent to Boston by the Boston *Globe*. That, I think more than anything else, woke up the press of the world to the advantage of the telephone. That article in the Boston *Globe* was copied all over the world and had a great influence in modifying public opinion.

On April 3, 1877, we talked perfectly freely between Boston and New York. On April 5, 1877, there was a lecture in Providence, Rhode Island, which was attended by a great many people, and speech was transmitted to Boston from Providence, and a bugler in Boston, who was well known in Providence, played, the sound being heard all over the large hall in Providence, Rhode Island.

On April 4, 1877, was opened the first telephone line specially built for telephonic purposes. It simply connected the office of Charles Williams, Jr., in Boston, with his house. It was a short line, but it was the first of the hundreds of thousands of miles of telephone wire that has since been laid.

Aspects of Public Ownership.

Can any line be drawn between those enterprises that should be in public hands and those that should not? Is there any principle that can be laid down for guidance, or any formula at once explicit and comprehensive enough to serve as a touchstone in all emergencies?

The answer is that no such simple solution of the difficulty has been, or probably ever will be, arrived at. But there are certain considerations which when taken together may serve as something more than makeshift direction-posts. The most earnest advocates of public ownership, for instance, admit that a municipality is not justified in attempting to meet any demand which is not sufficiently extensive and constant to keep the necessary plant fully employed. The most ardent opponents of public ownership, on the other hand, admit that in the case of many utilities the balance of advantages points to their municipalization. Thus no one objects to seeing sewerage systems, markets, water works, baths, cemeteries, and slaughter houses in public hands, while a very strong case, as a rule, can be made out for turning over harbors and docks to the management of the local authorities. In all these cases where municipalization is generally held to be necessary, it appears that there are three conditions usually fulfilled. (1) The enterprise is one which would be a complete monopoly were it in private hands. (2) The services rendered are of great importance to the community at large. (3) The fair price to be paid for the work performed is not readily estimated in advance. When an undertaking fulfils these three conditions the argument for bringing it under public ownership, with or without public operation, is so strong as to be practically overwhelming. Every absolute and irreplaceable monopoly supplying a community with some essential utility on terms that cannot be regulated beforehand is *ipso facto* a fit subject for municipalization.

It is rather, however, over those enterprises that tend to become monopolies and that present no insuperable difficulties of public supervision and control—such as gas works, electric lighting, street cars and telephones—that the battle for and against municipalization has chiefly raged. And here the example and experiences of Great Britain are of the first value and importance. No country in the world has plunged so heavily into the policy of municipal trading and none shows its good effects and its bad effects more plainly. The local debt of the United Kingdom amounts to over $3,000,000,000; capital sunk in reproductive undertakings exceeds $1,500,000,000; the average per capita debt of the eighteen leading British cities is some $114.

—Sidney Brooks, in *The North American Review.*

THE GROWTH OF PLANTS BY MEANS OF ELECTRICITY.

BY F. L. COOK.

In recent times we have had brought conspicuously to the attention of the country the subject of the conservation of our natural resources. With this end in view, scientists and investigators of the Department of Agriculture have been carrying on experiments to determine how best to increase the crop yield of the various staples upon which we rely for our food products.

In these tests, among other things which have been tried out, we find electricity is coming to the front. Experiments recently made with high-frequency electric currents have shown wonderful results in the propagation of plant life. A series of investigations have just been completed in one of the large greenhouses of a suburb of the city of Chicago which should prove of great import to those who are interested in the development of the soil and its products. This work is being carried on by Richard Gloede, a prominent landscape gardener of Evanston. His building is fitted with every facility for making accurate and reliable tests as to the action of growing plants under the stimulus of electricity.

INTERIOR OF GREENHOUSE, SHOWING NETWORK SUSPENDED OVER GROWING PLANTS ON ONE SIDE.

Experiment work was started early in the spring of the present year, and the tests are just at this time drawing to a close. Stimulation of the plants under cultivation was obtained by high-tension electric currents. In the preparation of the hot-house beds, a single galvanized-iron wire was imbedded in the soil previous to setting in the plants. Suspended about four feet above the flower bed, or "bench," as it is technically called, was placed a network of wires put together so as to form about a twelve-inch mesh. At frequent intervals along this network short brass chains were suspended. The entire screen of wires was carefully insulated from the structure upon which it was stretched.

In operation, two wires lead from the source of energy, one of which is attached to the conductor imbedded in the earth, while the second wire is joined to the overhead network. Very high voltage and frequency is used, an electrical field being produced in the space occupied by the flower beds. In this way plants which are growing in the flower beds are directly under the influence of the electrical field.

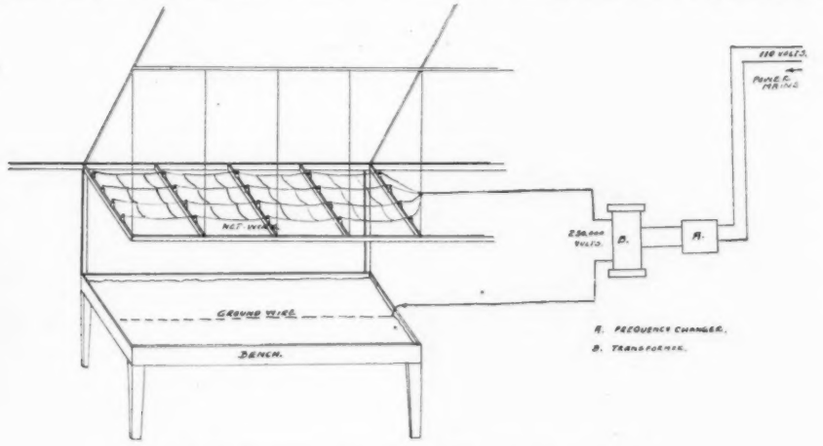


DIAGRAM SHOWING CONNECTIONS AND FRAMEWORK.

The apparatus utilized for the production of the high voltage consists of a transformer and a frequency changer. The outfit is connected to the secondary lines of the North Shore Electric Company, the local electric service company, which delivers the power at 110 volts and sixty cycles. The current first passes through a frequency changer. This raises the frequency from sixty to about 600 cycles, after which the electric current passes through a large transformer, which steps up the voltage to about 250,000. It is this voltage which acts on the growing plants. The present machinery consumes about four horsepower, being adapted to a twenty-acre field.

The results of the tests made are truly remarkable and have exceeded the expectations of the experimenters. It is interesting to note the growth of chrysanthemums, a large number of which are annually grown by Mr. Gloede for the Chicago flower markets. When the plants were first set out, two beds were prepared side by side, and exactly alike, except that one bed was wired for electrical treatment, while the other was not. The bench which was not wired was planted with a select lot of shoots while the "electric" bed was filled with the culls and weak plants which had been discarded from the first lot. The latter bed was kept constantly under the influence of the electric current while the other was allowed to grow in its natural way.

It was early noted that fungus growth, which is so prevalent in hot-house soils, and is responsible for the death of large numbers of plants, due to its parasitic growth on their roots, was in turn attacked by the electrical waves and in a short time entirely disappeared.

The plants, however, were not adversely affected, and began to show a rapid growth. It was found necessary to pinch their tops off several times in order to keep the stalks down to a marketable height. In addition, it was observed that the electrically treated chrysanthemums were much hardier than the naturally grown plants. Hot-house flowers are planted very closely together to economize space, and consequently, as the flowers grow toward maturity, they help to support each other, with the result that their stalks are generally weak, and when the plants are transferred to pots for sale, there is considerable loss through

breakage. In the course of the experiments it was found that the energized plants were thoroughly self-supporting and furthermore showed an average of twice as many blooms on each plant.

Tests were also made on the growth of roses and carnations, and it was found that by using the electrification process, about four times the yield could be obtained from a regulation bed in the same length of time required by former methods of cultivation. Also, there was a marked absence of stem rot, which is a characteristic ailment of these plants.

Interesting results were obtained in the open-air garden situated in the greenhouse yard. This place was equipped similarly to the hot-house

MR. GLOEDE AND TWO CHRYSANTHEMUMS
On His Right, Plant Subjected to Electrical Stimulation.
On His Left, Natural Growth from Selected Stock.

beds, having a network of wires suspended about eight feet above the ground and covering a garden plot approximately fifty feet square. In this space was planted the usual assortment of garden truck. The plants were given no assistance other than being electrically treated and properly cultivated, relying entirely on the rainfall for their water supply. All varieties thrived continuously, showing good growth even through the nine weeks of extremely dry weather which prevailed last summer.

Radishes were grown three inches in diameter which retained their flavor and showed no signs of being pulpy and stringy. Tomatoes and corn grew to unusual size, at the same time keeping their uniformity of shape. The bumper crop, however, was the muskmelons. These were planted from seed on the eighth day of June, in a plot of ground twenty feet square, and in nine weeks, lacking three days, 362 melons were harvested, all ripening at practically the same time. A peculiar feature of the electrification treatment is that the melons, and also beets, were made noticeably sweeter.

Mr. Gloede does not confine the use of electricity alone to the propagation of plants. His entire grounds are a model of modern illumination. The greenhouses and residence adjoining are brilliantly lighted with tungsten lamps, while a cluster lamp-post serves to display the beauties of the landscape gardens at night.

Electricity and Plant Life.

The study of economic biology is gaining a good deal of attention at the present time, and those engaged in research work have been able to secure results which suggest that there are enormous possibilities in the application of electricity to agriculture and horticulture. Very interesting and valuable results have been obtained in England by Professor Lemstrong, Sir Oliver Lodge and J. E. Newman.

The investigators claim that the growth of almost all cereals, fruit and vegetables can be increased and stimulated by the application of electricity, and, what is equally important, that the products can be gathered earlier. Their statistics go to show that the increase in quantity in certain cases is very high—strawberries 36 per cent, tomatoes 20 per cent, beets 30 per cent, cucumbers 17 per cent, wheat 29 per cent and barley 9 per cent more grain and 12 per cent more straw. In the case of barley, the germinating process which is used by brewers occupies about 27 days, but this period is reduced to 13 days with the assistance of electricity, while it is also claimed that the percentage of germination is greater. These data have been obtained as the result of most carefully conducted experiments, and the question naturally arises as to the possibility of a general co-operation between science and agriculture on these lines. In other words, is it possible to secure apparatus in such a simple form, and at such a reasonable figure, that ordinary nurserymen and farmers will feel tempted to call the power to their aid?

That is a question to which Thomas Clark claims to have an affirmative answer. He has built and patented a machine which is really an influence machine, and by the application of high-tension electricity a continuous current from insulated overhead wires can be discharged. The machine has six plates which are mounted on ball bearings, and the spindle does not pass through the plates, which is the case with all Wimshurst machines. These plates are driven by a special gear adjustable from the outside of the glass case which incloses the apparatus. The chief advantages of this spindle are that there is less friction, and that lubricating oil does not get onto the plates.

There are several other novel features designed to give the machine increased efficiency. For instance, there is an ingenious arrangement for drying the air whch passes into the case, and at the same time the dust is extracted. This is drawn off by a pump-like arrangement in which the exhaust of the small oil engine used for driving the machine is turned to a useful purpose. This arrangement renders the machine indifferent to the atmospheric whims which are so often a source of annoyance to electricians, and it is as effective when the weather is damp and muggy as on a dry, frosty day. Other features are an absence of sectors from the plates; sliding removable electrodes which can be easily taken out for cleaning or adjustment purposes, and also the side terminals. When terminals are fixed on the top of the glass case, there is a leakage through the particles of dust which accumulate on the surface, but this is avoided by the side terminals. Although 600,000 volts is used, the appartus is so designed that the man in charge has complete control over any wires placed in a greenhouse, or elsewhere, and the danger is practically nil.

The machine which Mr. Clark has just built is shortly to be put to a practical test in one of the largest nurseries. The purchasers have evidently realized that there is a chance of obtaining early crops, and in order to secure the best results they have erected a greenhouse on the lines desired by Mr. Clark.

Statue of Lord Kelvin.

A statue of Lord Kelvin is to be erected in Glasgow, close to the University, in the near future.

ELECTRICITY IN A BOLT FACTORY.

POWER PLANT OF THE CONTINENTAL BOLT & IRON WORKS.

The Continental Bolt & Iron Works, Chicago, has recently moved into a new factory building located on Forty-third Street near Western Avenue, in which every provision has been made to utilize electric power. The plant arrangement is such that the usual labor necessary in a plant of this character for handling the raw and finished product has been eliminated to a great extent, electric cranes of all sizes being employed. Motor drive is used throughout, the total rated horsepower of the motors installed being about 885.

ENGINE ROOM OF CONTINENTAL BOLT & IRON WORKS.

The new plant consists of two main buildings and a power plant in a separate building. The heading and threading buildings are each 263 feet long, but provision has been made for increasing each of these buildings to practically double its present length without interfering with the arrangement. The power plant building is 45 feet by 92 feet, divided into two parts; each 45 feet by 45 feet. The boiler room is twenty-seven feet high; both practically at ground level.

The service of the power plant is furnishing electric current for lighting and power in the factory, supplying compressed air for the oil furnaces, heating the buildings and handling fuel oil.

The boiler room, shown in one of the accompanying illustrations, contains two Stirling water-tube boilers each of 200-horsepower capacity, and provided with a Green chain-grate stoker. The boiler room also contains a Cochrane heater and receiver. The plant is arranged for the installation of three boilers, one more to be added when the factory buildings are extended. There is a radial-brick chimney, 60 inches by 125 feet, to which the boilers are connected by means of an overhead steel breeching. The chimney was built by the Custodis Company, and is equipped with Ajax lightning protection.

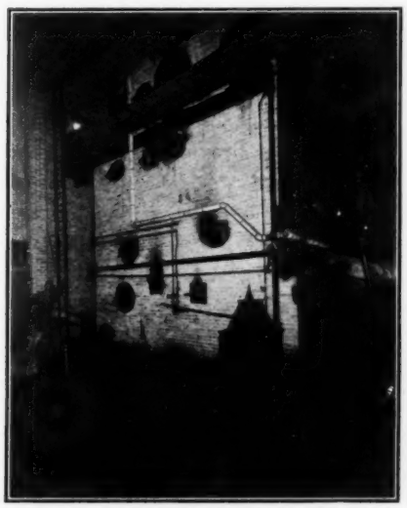
The engine room contains a 250-kilowatt unit, consisting of a Sprague generator operating at 250 volts and 120 revolutions per minute, mounted on a Nordberg Corliss engine 20 by 36 inches, having a long-stroke gear. The current is delivered to a two-panel switchboard, from which it is carried in two mains to the heading and threading buildings.

The engine room also contains an Ingersoll-Rand air compressor with cylinders 12 inches and 18.25 inches by 12 inches. There are two 7 by 4 by 10 center-packed Platt duplex boiler-feed pumps in the engine room and also a National Supply Company duplicate equipment for handling fuel oil. A general view of the engine room giving an idea of the arrangement of this equipment is shown herewith.

There is an outdoor pipe line carrying the steam, air and oil mains to the factory buildings. This line consists of cedar poles and A frames set in concrete. The line has heavy cross-arms from which the pipes are suspended and on which are mounted the electric cables. The steam pipes are insulated with magnesia covering, protected from the weather by means of roofing material secured to the covering itself.

The steam piping is simple and direct; the header and steam lines are relatively small, large separators being mounted on steam-using machines.

The heating consists of direct radiation, most of which is suspended from the roof trusses. There is a vacuum pump in the main building operated by an electric motor, and each radiator is provided with a Dunham trap. The heating system and vacuum pump are designed for operation at atmospheric pressure while the engine is in service. It is also arranged so that the vacuum pump can be shut down and the plant operated as a low-pressure gravity installation when neither electric power or exhaust steam is available.



BOILER ROOM.

The piping was done by John R. Kehm Company, the pipe covering by the Western Roofing & Supply Company. The switchboard and cables were furnished by Kohler Brothers.

The arrangement of the factory was planned by J. G. Hempstead, superintendent of the Continental Bolt & Iron Works, while the power plant was designed by W. L. Fergus & Company.

Exports of Copper.

Exports of copper for October totaled 21,904 tons. The amount for last year was 27,512 tons.

INSPECTION AND INSURANCE OF ELECTRICAL MACHINERY.[1]

BY MICHAEL LONGRIDGE.

The increase in the business of the electrical department during 1910, as compared with 1909, was as follows:

	Dynamos.	Motors.	Starters or Controllers.	Totals.
Machines insured, increase per cent....	6.2	12.5	17.6	14.0
Breakdowns, increase per cent	22.4	11.2	16.0	12.8
Cost, increase per cent	35.2	15.2	10.2	17.6

The rates of breakdown among the various classes of machines were these:

Dynamos—Continuous current 1 in 16.5; alternating current 1 in 5.3.

Motors—Continuous current 1 in 8; alternating current 1 in 12.

Dynamos and Motors—Continuous current 1 in 8.8; alternating current 1 in 11.2.

Starters and Controllers—1 in 25.4.

The proportion borne by the continuous to the alternating-current machines covered by insurance during 1910 is given below, and corresponding figures for the previous nine years are added to show how this proportion is gradually changing:

	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910
Dynamos—										
Per cent C. C...	98.2	98.0	98.0	97.5	97.0	97.0	96.5	96.0	95.0	94.5
Per cent A. C...	1.8	2.0	2.0	2.5	3.0	3.0	3.5	4.0	5.0	5.5
Motors—										
Per cent C. C...	96.5	97.0	95.5	93.5	92.5	91.5	89.0	86.5	84.5	83.5
Per cent A. C...	3.5	3.0	4.5	6.5	7.5	8.5	11.0	13.5	15.5	16.5
Total—										
Per cent C. C...	97.0	97.0	96.0	94.5	93.0	92.5	90.0	87.5	86.5	85.5
Per cent A. C...	3.0	3.0	4.0	5.5	7.0	7.5	10.0	12.5	13.5	14.5

The proportion in which the various parts of the dynamos, motors, starting switches, and controllers, insured in 1910, caused or initiated the breakdowns of the year, are tabulated below, with the corresponding figures for 1909, and for the preceding eight years:

Description of part which is believed to have failed first.	Dynamos. Average for 8 years previous to 1909.	Dynamos. 1909.	Dynamos. 1910.	Motors. Average for 8 years previous to 1909.	Motors. 1909.	Motors. 1910.
Rotating parts carrying current—						
Armatures and rotors, per cent.....	54.0	40	43	49.5	37	33
Commutators and slip rings, per cent.....	22.4	29	25	22.5	27	26
Stationary parts carrying current—						
Magnet coils and stators, per cent.....	8.9	12	13	13.9	20	17
Brush gear and terminals, per cent.....	....	3	2	....	4	5
Rotating parts not carrying current—						
Shafts, spiders, cores, binders, pulleys and gear wheels, per cent.....	14.7	12	13	14.1	7	9
Stationary parts not carrying current—						
Frames, pole pieces, bearings, etc., per cent..		4	4		5	10
	100.0	100	100	100.0	100	100

As a large majority of the machines insured are motors, it may be interesting to tabulate the figures for continuous and alternating-current motors separately, as follows:

Description of part of which is believed to have failed first.	C. C. Motors. 1908.	C. C. Motors. 1909.	C. C. Motors. 1910.	A. C. Motors. 1908.	A. C. Motors. 1909.	A. C. Motors. 1910.
Rotating parts carrying current—						
Armatures or rotors, per cent.....	38	39	33	21	23	30
Commutators or slip rings, per cent.....	29	31	29	2	6	5
Stationary parts carrying current—						
Magnet or stator coils, per cent.....	11	15	15	53	49	38
Brush gear and terminals, per cent.....	6	3	6	0	8	2
Rotating parts not carrying current—						
Shafts, spiders, cores, binders, pulleys, gear wheels, etc., per cent.....	84	88	83	76	84	73
Stationary parts not carrying current—	9	7	8	6	6	5
Frames, pole pieces, bearings, etc., per cent..	7	5	9	18	8	22
	100	100	100	100	100	100

CAUSES OF BREAKDOWN.

Cause of Damage.	Dynamos. Average for 8 years previous to 1909.	Dynamos. 1909.	Dynamos. 1910.	Motors. Average for 8 years previous to 1909.	Motors. 1909.	Motors. 1910.	Starting Switches and Controllers. Average for 4 years previous to 1909.	Starting Switches and Controllers. 1909.	Starting Switches and Controllers. 1910.
Accident, per cent	10.9	5	4	7.9	2	5	13.7	5	9
Dirt and neglect, per cent.....	18.7	20	16	21.9	26	24	12.5	19	9
Age and deterioration, per cent.....	24.2	16	29	22.8	14	18	25.7	17	30
Bad work or design, per cent.....	20.4	23	23	15.4	14	16	8.0	14	10
Overloading, per cent.....	2.2	1	0	4.5	1	1	4.8	2	2
Unascertained, per cent	23.6	35	28	27.5	43	36	35.2	43	40
	100.0	100	100	100.0	100	100	100.0	100	100

Description of part which is believed to have failed first.	Starting Switches and Controllers. Average for four years previous to 1909.	1909.	1910.
Parts carrying current—			
Resistance coils, per cent	52.0	52	57
Contacts and switch arms, per cent.....	10.8	9	12
Automatic apparatus, per cent	14.0	21	18
	76.8	82	87
Parts not carrying current—			
Frames, slabs, carriers for coils, springs, etc., per cent	23.2	18	13
	100.0	100	100

[1] Report by the chief engineer of the British Engine, Boiler and Electrical Insurance Company on electrical machinery and apparatus coming under his supervision.

The causes of the year's breakdowns were probably as given in the above table.

Automatic Telephone Message Recorder.

An apparatus recently invented by Albert Baumgartner, of St. Gall, Switzerland, is said to record telephone communications in the absence of the person called up and to actually reproduce them when desired. While the apparatus does not appear to be very complicated, it is nevertheless ingenious, consisting of a microphonic telephone and a dictating machine with cylinder and sound interceptors. The receiver having been left unhooked by the absentee, the spoken words are recorded on the cylinder which is set in motion, and upon his return the instrument readily reproduces the message.

At the moment the call is made from the sending station the circuit (consisting of the line wire, the coil, and a pawl) is closed, the pawl being attracted to the electromagnet and the ratchet wheel of the talking machine released, the recorder cylinder being thus set in motion. The pawl is so pivoted that its tendency is always to gravitate away from the electromagnet and engage itself with the ratchet wheel, so as to prevent the rotating of the cylinder. During the period a message is being received, however, the pawl is attracted by the electromagnet. When the connection is broken the circuit is interrupted and the pawl falls by its own weight onto the ratchet wheel which is fixed to the cylinder, and thereby the rotary motion of the latter is prevented from taking place.

Are Electrons Impenetrable?

The doctrine of the impenetrability of matter is now assailed. Professor Bragg, in a recent article in *Science Progress*, states that there is very strong evidence that any two atoms, or even any two electrons, can pass through one another, given sufficient relative velocity of approach. In some cases the velocity would have to approach the velocity of light, but this condition is fulfilled by some of the particles shot off from radium.

Electrical Notes From Great Britain.

By Our London Correspondent.

The Cleveland & Durham Electric Power Company has reported a greatly improved position increasing its annual gross profit from $64,710 to $105,000. In June last the connected load aggregated 40,460 horsepower, an increase of 4,177 horsepower, with a further 12,500 horsepower ordered and important negotiations pending. Arrangements have been entered into for operating four additional waste heat stations including two ironworks at Redcar, and the Port Clarence works and Ayresome Ironworks.

In consequence of the big demand at Bury for industrial power, the municipal electricity department had to install a second generating station, and the equipment is in a sufficiently advanced state for power to be supplied. The work is, however, not quite complete, and particulars are promised shortly. The opening took place quite unceremoniously a week or two ago. Briefly stated the equipment consists of three Woodeson water-tube boilers evaporating 25,000 pounds of water per hour, and two 2,000-kilowatt Siemens alternators driven by Zoelly turbines. Last year Bury had an increase of twenty-four per cent in its power load. The Fife Electric Power Company has added a further 2,500-horsepower turbine-driven generator (British Thomson-Houston) at its Townhill station. Two of the London municipal electric supply authorities (Poplar and Stepney) have been conferring elaborating a scheme whereby they will help each other in the way of plant extensions so as to economically meet increased demands. Stepney will give Poplar a certain supply until 1913; Poplar will help Stepney up to a specified maximum from 1913 to 1917 with subsequent provisional agreements, beyond that date, and each authority must store sufficient coal to meet three weeks' requirements in winter. Poplar will have to install a further 3,000-kilowatt turbo-generator, boilers and coaling apparatus at a cost of over $100,000. The Council is now ordering a Willans-Parsons turbine and three-phase alternator with condensing plant at a cost of $38,000. At Sheffield the co-operative spirit is evidenced in the investigation recently ordered of the advisability of the electricity supply and tramway departments—each of which has its own generating station—arranging for a mutual transfer of electrical energy as occasion may require. An estimate of cost is being prepared.

Birmingham is acquiring a site on which it proposes to erect a further generating station for high-tension power supply at a cost of $1,125,000. The Bradford municipal electricity department reports a large increase in demand for energy consequent upon reductions of charges and the introduction of a new graded system of charging. More consumers have been added than in any previous year. Small power users took an additional 500,000 kilowatt-hours. Liverpool Corporation added 305 new electric motors (1,300 horsepower), and the power demand for such purposes was thirty per cent better than last year. An interesting part of the year's work has been the connection of nearly ninety dwelling houses to the circuits on the Wavertree Garden City Estate; it is not unlikely that a further 1,700 houses may also follow suit. According to reports from several parts of the country a number of municipal corporations have decided to seek powers in the next session of Parliament for carrying out electric wiring work. Swindon electricity works plant is to be extended, and after discussion whether it should be by means of steam turbines or Diesel oil engines (250-kilowatt sets) the recommendation of the engineer in favor of the latter has been adopted.

The recent awakening of British industrial works to the advantages of electrification found expression in the speech of John Kerr to the stockholders of Dick, Kerr & Company, Limited. He said that though England had once lagged behind Germany and America in the adoption of electricity for ironworks, textile mills and other industrial works the greatest interest had now been awakened. A considerable amount of generating machinery had been ordered and many important installations were under consideration. Mr. Kerr said that keen competition continued in all departments of the business, and they were now completing metal-filament lamp works in connection with which they were availing themselves of the experience of a Continental company in order to avoid the danger of experimental work. This is quite a new field for this company, which hitherto has devoted itself to electrical machinery and installations, permanent-way contracting and rolling-stock work.

The British Thomson-Houston Company, Limited, has during the past year carried out important extensions to various parts of the factory at Rugby, but notwithstanding these increased facilities, the works are stated to be as full of orders as they could be. In the general electrical departments the orders in hand are considerably in excess of those on the books a year ago, and in the Curtis-turbine section there have never before been so many turbines under construction. Special attention is now being centered on the selling of Mazda lamps, new stock rooms for the sale of these and of wiring supplies having been taken in London and Manchester. These are parts of the company's advertising scheme. Mr. Nauheim, the chairman, told shareholders at the annual meeting in London on October 19 that the big increase in business came too late to be reflected in the accounts for the year ended at March last. He also added that though there was this growth in volume of business at present, and though they were continually adding to their capacity for production, the percentage of profit remained low as competition was almost as keen as ever. In future the accounts would be made up at December. The balance sheet submitted at the meeting showed a profit after paying interest on debentures and loans of $31,870, out of which $26,715 has been placed to depreciation of apparatus, meters, supplies, etc., and $3,140 to other depreciation.

The scheme of the British Electric Traction Company for rearrangement of the rights of the preferred and common stockholders has been the subject of a great deal of discussion and a full meeting was held in London on October 17, E. Garcke presiding. There were signs of strong organized opposition, but when the meeting was held it transpired that the chief objecting parties had agreed to approve the scheme subject to modification after

conference between representatives of the conflicting interests and the board.

The Olympia Electrical Exhibition closed its doors on Saturday, October 21, and we are now settling down to normal living again. On the whole the event must be described as a success. There is little to be enthusiastic about, however. Exhibitors, speaking generally, have done fair business, and they know each other a little better than they did before, but there is a good deal of complaining that the public was not drawn to Olympia as by a huge magnet throughout the entire month to see the electrical manufactures and demonstrations. In the third week, as the newspapers paid greater attention to the exhibition, the people came in fairer numbers, at times even in crowds, but criticism and disappointment still continue because the event has passed without a sufficiently great appeal of modern electricity being made to the public. Advantage was taken of the opportunity to bring the claims of the reorganizing Electrical Manufacturers' Association into prominence by a dinner held while the exhibition was in progress.

Now that the exhibition is an event of the past, the time of society meetings is at hand. The Faraday Society has already held two meetings, the Physical Society is also assembling, the Institution of Mechanical Engineers re-opened on October 20, and the Institution of Electrical Engineers starts off with an address at the Manchester Local Section on October 27 by the chairman, W. Cramp. The program of this section as it appears on paper is an excellent one, as shown by the following subjects which will demand attention between now and April next: Mechanical design of direct-current turbo-generators; the function of the laboratory in the training of an engineer; automatic reversible battery boosters; heat conductivity in electrical machinery; recent developments in turbine practice; electrical furnaces; specifications; high-tension porcelain insulators; the mechanics of electric train movement; the corrugation of rails; recent developments in the application of electricity in textile factories, and last of all a lecture by Dr. R. Thury. The members of the students' section at Manchester also have a good program, the items including two debates, one on the question, "Would Co-partnership Be Preferable to Trade-unionism for the Electrical Industry?" and the other on "Direct Current Versus Alternating Current for Industrial Purposes." On October 31 J. F. C. Snell of London is going to address the students, part of his remarks relating to modern power stations in South America, for which he has been responsible as consulting engineer.

ALBERT H. BRIDGE.

London, October 23, 1911.

The Faraday Society.

A meeting of the Faraday Society was held on October 3 in London, with Vice-President F. W. Harbord in the chair.

John Harden read a paper on "The Paragon Electric Furnace and Recent Developments in Metallurgy."

In this furnace the surface of the slag is heated by means of arcs, and the bath is also heated from the sides and beneath by means of side plates as in the Roechling-Rodenhauser furnace. The furnace is, in fact, a combined arc and resistance furnace. In this way the maximum heat can be applied exactly where desired; during desulphurization and dephosphorization to the slag, and during the period of degasifying to the bottom and sides of the bath. Incidentally, the arcs enable the furnace to be started from the cold, while the use of the side electrodes enables large, expensive carbons to be dispensed with, and, of course, larger units to be built, as only a small proportion of the power enters the furnace through the arcs. In a fifty-ton furnace the electrode cross section need only be 24 by 24 inches, corresponding to a twenty-ton ordinary arc furnace. A further incidental advantage claimed is the greater durability of the roof. If desired, gas firing can be used in place of the arcs, in conjunction with the side electrodes. In a trial furnace now being built in Germany, side plates only are provided for.

Donald F. Campbell read a paper entitled "Progress in the Electrometallurgy of Iron and Steel."

The author stated that although few fundamental principles had been introduced during the last few years, the all-important evolution from the laboratory to the commercial stage had been accomplished in many electric thermic processes, and that increased efficiency and reduced cost were the problems receiving the most attention at the present time. The influence of the cost of power supply in the geographical distribution of electrochemical industries was then discussed, and special reference was made to the water power of Scandinavia and the Alps, which were taken as examples of districts where cheap power supply was available, and consequently those industries in which power supply is of prime importance were most highly developed, such as the manufacture of ferro-alloys and smelting of iron ore. Two types of water-power station were then described; as examples were mentioned those in Trollhättan in Sweden, and L'Argentière in France. The advances in the electrometallurgy of iron and steel were then briefly mentioned. The author stated that the manufacture of pig iron by electricity was only likely to make headway in Scandinavia and Western America; but he stated that in those countries, where the conditions were altogether exceptional as regards the absence of coke and a cheap supply of water power available, the electric smelting of iron had been proved conclusively to be able to compete with small Swedish blast furnaces in cases where the price of power was below $8 per kilowatt. That the development of Scandinavian water powers would do much to compensate the exhaustion of the wood supplies, was the most important result of the introduction of this process, and the author stated that this new development would strengthen Sweden, especially in the North; but he went on further to point out that another important development would probably restore the balance to a great extent, namely, the electric refining of steel, which could be carried on in any country irrespective of low cost of power. Comparison was then made between the local conditions in Sweden and California, where the most striking developments have taken place, and the process had been developed from a theoretical to a commercial and profitable basis. The process had been established for the manufacture of many classes of tool and special steels, but the question before progressive steel-makers at the present time was whether the electric furnace could be generally applied in conjunction with the basic or acid Bessemer converter to compete with open-hearth steel in the matter of cost. He said that it could compete only with best acid open-hearth steel for price at the present time, though many German and American engineers were giving this problem the most serious consideration, and several twenty-ton electric furnaces were being erected with complete confidence to prove the economy of this application as a duplex process in competition with ordinary open-hearth practice. Curves were shown giving the results of over one hundred tests, which proved very clearly the superiority of electric steel as compared with material made in the open-hearth furnace. The author further discussed the special case of Germany, which is dependent on the basic Bessemer process for the production of cheap steel, and stated that this method of manufacture was not sufficiently reliable for modern requirements, and some improvement in quality was essential, and that this could be provided by electrical refining. If the process were generally applied to the basic Bessemer, the output of Germany alone would involve a very wide application of electricity. The author also pointed out that during the last two years many improvements in detail had been made and the power consumption for melting and refining scrap had been reduced to as low as 600 kilowatt-hours per ton of steel over long periods.

E. Kilburn Scott gave a description of the Hering furnace.

Hearing on Wireless Rules.

A public hearing was held on October 26 at the office of Benjamin S. Cable, acting secretary of the Department of Commerce and Labor, regarding the present wireless regulations and possible changes in them. One of the subjects considered was that of auxiliary power for the operation of the wireless apparatus, in the event of the regular source of power from the ship's dynamo being interrupted or not available.

Regulations governing wireless equipment, passed by Congress in June, 1910, became effective July 1 of this year.

Electrical Notes from Continental Europe.

By Our Paris Correspondent.

It appears likely that the power-transmission project from the Rhone River to Paris will be carried out before long. This undertaking is one of an unusual scope, as it calls for a supply of 200,000 horsepower to be carried upon a 120,000-volt power line for a distance of 300 miles. An official commission has taken up the matter recently and is engaged in drawing up the plans for the enterprise according to the most recent engineering progress. American practice is called upon especially in laying out the power line, and for this reason it is considered that a voltage as high as 120,000 or perhaps even 150,000 volts can be adopted without any trouble. The power of the Rhone will be used at a point not far from the Swiss frontier. Mr. Lugeon has been examining the geological conditions of the region, and Mr. De Valbreuze the question of the hydraulic and electric plant. It is proposed to erect a dam across the Rhone from which will proceed a short canal of 150 feet width and 25 feet depth. The turbine house is fitted with sixteen penstocks for use with 20,000 horsepower turbo-alternator units, working upon a 230-foot head of water. Instead of the high-voltage direct-current system which was advocated in the old project, the engineers prefer to use the three-phase system at 120,000 volts and twenty-five cycles. The turbine house will be a building of about 1,000 feet length and will contain sixteen units of a uniform size. On a higher level will be erected a transformer house of about the same length, and the cables will run between the two in a series of tunnels. Each unit in the turbine house consists of two Francis turbines mounted on a common horizontal shaft and direct coupled to a 20,000-horsepower alterator.

The transformer house will have three long parallel halls to provide for as many different voltages, seeing that 120,000 will be used for the Paris line, 30,000 volts for the surrounding districts, and 12,000 volts for local use A large part of the current for local use will serve for the electrochemical industries and will thus tend to equalize the load. Four power lines will be run to Paris, and these will be mounted on structural iron poles following the recent American practice. The power line will be divided into sections of sixty miles length.

During the Turin exposition, members of the International Electrotechnical Commission had an opportunity of visiting several of the most recent electrical enterprises in the north of Italy, and among these was the new Chiomonte hydraulic plant which supplies the city of Turin and is among the largest in the south of Europe. We will mention a few of the leading points about this plant.

The station lies on the Dora Riparia stream, and uses a 1,060-foot head of water. It contains at present four turbines of the Pelton type and 5,000-horsepower size, direct-coupled to three-phase alternators. These machines work at 8,000 volts and fifty cycles, and it is proposed to erect other groups of the same kind before long. The plant contains four three-phase transformers of 3,500-kilowatt size which serve to raise the voltage to 50,000 volts for the power line. Part of the current from the turbine plant is delivered to the Mt. Cenis tunnel where it serves for the electric traction on the tunnel section. A substation is erected near the tunnel for this purpose. But the greater part of the current is sent over the main power line to the Martinetti substation which serves for the city of Turin. The present power line is about thirty miles long and it is mounted on structural-iron poles. The substation contains 3,-500-kilowatt transformers so as to lower the voltage to 6,600 volts for the city mains. A steam plant of some size is also installed here, containing six Babcock & Wilcox boilers and two Parsons steam turbines of 5,000-horsepower size connected to alternators. For the city tramways there are being mounted three rotary groups of 1,000-kilowatts and a large storage battery. The 6,600-volt, three-phase current is sent into two sets of underground mains, one of which feeds a three-wire secondary at 500 volts for power use, and the other a four-wire secondary with grounded neutral wire at 220 or 125 volts for the lighting current.

Recent data regarding the operation of the new three-phase electric railroad which runs from Genoa to Busalla states that it is one of the lines belonging to the Italian government railroad system, and was built in order to afford a ready means of transporting coal from the port of Genoa across the mountain region to the leading centers, such as Milan and Turin. An electric line was much preferred in the present case owing to the heavy grades and numerous tunnels in the mountain district. It uses three-phase current at 3,000 volts, with overhead trolley and third rail, and runs electric locomotives of sixty-five tons adherent weight. The four axles of the locomotives are driven by two non-synchronous 500-kilowatt motors, these being connected in series for starting and in parallel for normal running. Such locomotives take 600-ton trains as a general rule. Both the electric line and the new steam plant which furnishes the current have been installed by the French Westinghouse Company.

The steam plant uses two 5,000-kilowatt turbine-alternators of the Parsons type which deliver three-phase current at 15,000 volts and fifteen cycles to the various substations lying on the railroad, and in these it is raised to high voltage for the trolley line. There are run on the average seven coal trains per day on the present line. Owing to the interesting features which it presents, it was one of the subjects for discussion at the Turin Congress, and was also visited by the delegates.

The machinery hall of the Exposition contains a number of engine groups, all of which represent the most recent practice in the various lines. The Ganz Company of Budapest has one of its new steam-turbine sets in which a Blathy turbine is combined with a 6,-500-volt Ganz alternator. Diesel oil engines have a great interest for plants in the south of Europe where coal is at a high price. One such group was installed by the Swiss Sulzer firm, consisting of a 750-horsepower Diesel engine coupled to an alternator. Another Diesel engine of the same size is built by the Franco Tosi firm, one of the principal Italian engine constructors. It runs at 150 revolutions per minute and drives a Brown-Boveri 6,400-volt alternator. The same firm has two large boilers which are fired by naphtha fuel and supply a 1,000-horsepower hori-

zontal compound engine, driving an alternator.

Among the new electrical enterprises in Germany is a project for a large hydraulic supply in the region of Eisenach. The plans call for three separate dams across the valleys in order to form natural basins. One of the dams will be erected in the Emse valley above Winterstein, and the others in the Laucha and Leina valleys. Among the steam plants may be mentioned a large station which it is proposed to build for the use of Nuremberg and Fürth. It is likely that the Schuckert firm will receive the contract. For the town of Spandau and the surrounding region there is some talk of erecting a large steam plant. Among traction matters, we note that the new electric road from Bonn to Siegburg was opened for traffic recently. The municipality of Bonn is now engaged on a project for using electric traction on a number of sections of the Cologne-Bonn railroad and also to electrically equip the section of line known as the Vorgebirgs Bahn.

At Alamissa, in the southern part of Austria, there is to be erected a large hydraulic plant, and the contract has been awarded to a Trieste firm. The power of the Setina River will be used here, and it is estimated that this stream can furnish as much as 200,000 horsepower at a maximum. The first plant to be built upon the stream will take about 50,000 horsepower, and there will be erected two turbine units of 20,000 horsepower size, using the three-phase system. Power will be transmitted at 55,000 volts. One of the principal electric railroad sections in Austria is the Rakospalota-Gödöllo section which has been electrically equipped within a recent date, and forms part of the Budapest-Gödöllo suburban line. The electric section is about twenty miles long and takes in a well-populated district. We may also mention a project which is on foot for an electric railroad between Budapest and the town of Budakesz. Another Austrian project is an electric line which is to be built from the town of Brixen to Platzbon upon the Ploseberg heights. A short line is also to connect the localities of Mixnitz and St. Jacob. There is some discussion as to whether direct or alternating current should be used on the Paris suburban railroads which it is proposed to equip for electric traction. As will be remembered, the project is a most extensive one, as the work includes 130 miles of track and will cost about $30,000,000 to carry out. The present lines form part of the West State railroad system, this having been taken over by the state quite recently. The engineers of the railroad company had already drawn up plans for electric traction, considering the suburban lines as an extension of the city underground roads and for this reason they favored the use of the direct current with third rail as is used on the Metropolitan. However, it is the opinion among a number of outside engineers that the old project should not be simply renewed but should be abandoned for the single-phase system, and according to this idea the suburban lines are considered as part of the trunk lines. One advantage is that the local roads can be extended further into the country as time goes on, seeing that alternating current would undoubtedly be needed for trunk-line sections. Again, the use of the single-phase system would suppress all the substations. Another point is that in case of accident where passengers are obliged to descend from a train, they cannot come in contact with the current, as with a third rail, seeing that overhead wires are used. The fact that this current is accepted in principle by the Prussian, Swedish and Swiss governments for equipping the railroad lines in the future, and is already much used in various parts of Europe, speaks strongly in its favor.

A. De Courcey.

Paris, October 17, 1911.

Beginning of New Zealand's Water-Power Development.

An American consular officer in New Zealand has furnished some very interesting reports regarding the wealth of water-power resources which that country possesses. He is quite enthusiastic about the results of the New Zealand Government project to develop these resources.

A definite beginning of some of the important water-power enterprises planned by the Government is about to be made at Lake Coleridge, where power is to be developed for transmission to Christchurch, Lyttelton, and adjoining towns. Probably about $250,000 worth of hydroelectric power machinery will be required at once, and American manufacturers of such machinery should be on the lookout to secure this important business.

With regard to the general scope of the Government's proposed water-power enterprises, the following reference to the same made by the Prime Minister in his recent budget speech to Parliament may be of interest:

Important progress has been made in the direction of giving effect to the decision of Parliament to bring into profitable use the latent power in our rivers and streams by the development of electrical energy on a large scale. The Government has secured the services of Evan Parry, a professional gentleman of high standing, with considerable experience of hydroelectric power schemes, to act as chief electrical engineer, and has appointed Lawrence Birks, another engineer with high professional credentials, as chief assistant to Mr. Parry in this work.

The policy of the Government is to develop one large project first and study results before embarking on a more extended program. With this end in view preparations are being made for developing a large scheme at Lake Coleridge and conveying the power to Christchurch, Lyttelton, and the surrounding districts, where there is likely to be a market for it from the outset. It is also hoped to demonstrate the advantage of electricity for haulage purposes on railways generally, apart from its value in special cases where the conditions are unusually favorable.

Inquiries are being made with a view to establishing within the Dominion new electrochemical industries which would obtain their power supply from the Government mains. One of the most promising is the manufacture of chemical fertilizers, for which there is likely to be a large and increasing demand throughout the world. With the natural conditions obtaining in New Zealand, it is probable that products of this nature could be manufactured on a large scale at a price which would make the industry profitable in itself and of benefit to the whole community. Another feature of the development of our water power on a large scale which would have an important bearing on the social life of the people is its possible influence in the home.

In my opinion, the day is not far off in New Zealand when, with an abundant supply of electrical energy available at a cheap rate, it will be within the power of most people to utilize the new power for all the lighting, heating and cooking required, without any trace of dust, dirt or excess of heat.

The estimates of expenditure and revenue in connection with the Lake Coleridge project indicate possible prices for the supply of current which warrant the hope that such a consummation is within the range of practical achievement in New Zealand. The important question of electrifying the Lyttelton tunnel, through which a large number of passengers travel annually, has received careful consideration, and the electrical engineer has been instructed to report upon this matter without delay, and to prepare the necessary plans, with a view to the work being put in hand at an early date. He has also been instructed to furnish a report upon the utilization of Lake Waikare-Moana for the supply of electrical power for lighting and industrial purposes in the North Island. This is expected to be available at an early date, and I am hopeful that the waste power latent there will before long be made available for the uses of the people.

Electrification of a portion of the Canadian Pacific Railway is said to be planned, the power to come from Adams River, where it is figured that 100,000 horsepower are available.

Central-Station Practice

ATMOSPHERIC PHENOMENA AND THEIR RELATION TO THE PRODUCTION OF OVER-VOLTAGES IN OVERHEAD ELECTRIC TRANSMISSION LINES.—II.[1]

BY G. V. ADENDORFF.

Energy of a Storm.—The total maximum energy of a storm at a given height above the earth is easily calculated, and per cubic mile is about 70,000,000 foot-tons. Given then the whole area of cloud facing the earth and its height when all of it is on the point of discharging, then the number of cubic miles of strained dielectric is known, and the energy of the storm approximates to 70,000,000 foot-tons per cubic mile. Since the potential required to produce a flash a mile long is so enormous, it follows that the quantity of electricity required for the energy need not be so great.

Sir Oliver Lodge states that 217 million electrostatic units of quantity per square mile would give the requisite bursting tension. Now 217 million electrostatic units are just about seventy coulombs, or not enough to decompose one-hundredth of a grain of water. It must not be supposed, however, that because the quantity is small the current is also small, for if the quantity flows only for a very short time, as in the case of lightning, the current may be exceedingly large, and no doubt this is usually the case.

With regard to the voltage of discharge, it is assumed of course that this is the maximum potential required, and that no "brush discharge" takes place. As, however, a brush discharge would probably occur before this potential value, the real potential of the discharge would be possibly a considerably lower figure. The point is, however, that the voltage is of the magnitude of millions of volts.

C. P. Steinmetz treats lightning discharges in the clouds in the following manner: Assuming a potential gradient of 100 volts per foot and estimating the average size of moisture particles as 10^{-4} inches at the commencement of agglomeration, then the breakdown potential of the air (*i. e.*, between 100,000 and 200,000 volts per foot) would be reached when the drops have reached a size of about 0.1 to 0.2 inch diameter, that is to say, about the size of rain drops. Estimating the average potential gradient in the discharge path as 50,000 volts per foot, the diameter of the path as one to two feet, and the specific resistance allowing for inductance as 100 ohm-centimeters, then the current would be about 10,000 amperes. The power, with this voltage and current, would be about 5×10^9 kilowatts for a discharge, two miles in length. Estimating the energy from photometric considerations as 10,000 kilowatt-seconds, the duration of the discharge would be about two-millionths of a second. The average wave-length of the discharge is calculated as being about 1,000 feet, and with a potential gradient of 50,000 volts per foot, the potential differences in the clouds would be about 50 million volts. The frequency of the discharge is calculated as being about 500,000 cycles.

Lodge distinguishes between two main cases of lightning discharge, and there can be no doubt that both exist:

(*a*) When the strain in the dielectric near the earth has been of gradual growth, in which case the path of discharge will be prepared inductively beforehand.

(*b*) When the strain arises so suddenly that there is no time for any prearranged path.

The first case he calls "steady-strain" and the second "impulsive-rush" discharges.

At this point it will be appropriate to deal with the oscillatory character of lightning, and then to show the effect of high-frequency currents in the conductor. There is no doubt now that the discharge from a Leyden jar or any other condenser is usually of an oscillatory character.

A direct experimental proof that a lightning discharge is oscillatory will only be obtained when photographs are taken of a flash on a plate revolving at a very high speed of say 1,000 times a second or more. The oscillatory character of lightning can be easily proved theoretically, but the mathematics involved are too cumbersome for a paper of this nature; it is sufficient, however, to say that the result of calculation brings out the frequency of discharge at anything over a million cycles per second. The following arguments are often brought forward to bear out the oscillatory character of lightning.

(*a*) The receiving circuits of wireless-telegraph stations are often tuned up to receive oscillations of frequencies of hundreds of thousand and more, and obviously a circuit so tuned cannot receive oscillations of a lower frequency. Further, it has often been observed that oscillations have been set up in the antennae whilst there has been a thunderstorm in the sphere of action. This is held as showing that lightning discharges set up oscillation whose frequencies must be very high.

(*b*) The coils of a transformer which have been subjected to an over-voltage produced by lightning, as a rule have only the first few turns at the entrance damaged. This shows that there must have been a fairly considerable difference of potential between the turns; in other words, the distance between the voltage maxima must have been small, and the frequency must have been great.

(*c*) It has often been observed that when an over-voltage due to lightning penetrates a power station, the discharge has jumped either across the conductor, where it makes a bend, or has jumped to the nearest "earth" in preference to flowing along the conductor whose resistance is so much smaller. This is a characteristic phenomenon connected with high-frequency discharge.

The Production of Over-voltages.—It has already been shown that atmospheric phenomena are connected with voltages which may have an enormous value, and with frequencies which may vary from zero to practically infinity. These phenomena of abnormal voltage and frequency are met with in electric circuits and it is now proposed to discuss them in detail.

Over-voltages in this paper will be classified according to the mode of oc-

[1] Abstract of paper read at a meeting of the South African Institute of Electrical Engineers.

currence, and so immediately come under the following category:

(*A*) Direct strokes.
(*B*) Steady electrostatic stress.
(*C*) Impulses or traveling waves.
(*D*) Standing waves or oscillations.

(*A*) *Direct Strokes.*—By this is meant an actual lightning discharge to the line itself. If the discharge is very heavy, as usually is the case, the probabilities are that a portion of the section struck will completely disappear, but if the discharge is not so severe, or if, say, one of the poles or masts is struck, then the line at the point struck is suddenly raised to an enormously high potential, and no insulation would prevent arcing over to ground. Such a voltage wave peak would probably set up a wave train which would travel along the line away from the point struck. This is analogous to the wave trains set up when a stone is dropped into water. The greater the frequency the steeper the wave front would be, and the less distance the wave would travel before dying out. It will thus be seen that the effects due to a direct stroke are purely local, and result in puncturing the insulation and arcing over, irrespective of the fact that protective gear may be installed in stations at the ends of the line. Although not the primary cause of danger to the apparatus in stations, they may of course set up secondary dangerous disturbances, resulting from an arcing ground or recurrent surge.

(*B*) *Steady Electrostatic Stress.*—The gradual accumulation of static charge on a line increases its potential with respect to earth, and in this way the line potential against ground due to "static" may become very great and ultimately may puncture the insulation or discharge over the protective gear, which ever presents a path of least resistance. The following causes contribute largely to this accumulation of static charge and consequent potential difference against ground of an electric circuit:

(1) The accumulation of static charge from rain, snow, fog or dust moving in the vicinity of the line.

(2) Potential difference between line and ground due to difference in altitude and change in temperature. It has already been pointed out that the potential at a point in the air increases with increasing height, and consequently abnormally high potential strains are produced in long transmission lines, running through mountainous country where considerable differences of elevation occur between different portions of the line. Sudden variations in temperature produce the same effect, though not so pronounced.

(3) Wind blowing across the line, especially in a dry climate such as exists in this country, where this effect is more pronounced in winter, and if the wind be accompanied by dust. If the lightning protective gear is efficient, this potential difference against ground may result in a series of discharges over the arresters following each other periodically. With inefficient protective gear, there is a probability of flashing over at the insulators or any weak spot in the insulation. The dangers arising from this accumulation of potential are (1) the liability of puncturing the insulation of the system, causing mainly insulator troubles; (2) the liability of producing, when they discharge to ground, other dangerous troubles, such as arcing grounds, short-circuits, etc., which ultimately may affect the normal working of the station apparatus.

(*C*) *Impulses of Traveling Waves.*—The most complex phenomena connected with lightning discharge are associated with traveling waves. Suppose a lightning discharge takes place between cloud and cloud or between cloud and ground, then immediately there is a redistribution of the electrostatic field, a general equalization of potential occurring at all points. Consequently there is a change in the electrostatic charge on the line, corresponding to the changed potential difference between cloud and ground, and the static charge so set free moves along the line as an impulse or traveling wave. Such a wave of potential may be enormous, with a steep wave front, that is, it rises very rapidly as a peak at its starting point. The impulse does not maintain this peaky waveshape, but gradually broadens out and flattens until it reaches the end of the line, and if the line were of unlimited length, it would vanish altogether.

Another source of impulses is that due to electromagnetic induction arising from a lightning discharge. A direct stroke passing over an overhead line will electromagnetically set up impulses on the lines due to induction. The process is exactly similar to the induction set up in the secondary windings of a transformer by the primary. The impulse in this case is only really serious when the stroke passes parallel to the lines, and so is more severe when discharges take place between cloud and cloud than when occurring between cloud and ground.

The three main external causes of impulses then are direct strokes and electrostatic and electromagnetic induction. In the latter case, it is fairly obvious that the voltage produced is not so great, but on the other hand, whilst in the case of direct strokes the damage done is generally localized, the effects due to impulses originating from induction are felt throughout the system. Generally speaking the damage done by such a traveling impulse is not very serious, but, as happens during a severe thunderstorm, owing to the fact that they may occur very frequently, there is always a probability of destructive internal surging being started. Traveling waves, however, directly cause most damage to transformers on the line, and it is often observed that the first few turns only on the transformer are punctured. This puncturing generally occurs between two conductors and seldom between the whole coil and earth.

(*D*) *Standing Waves or Oscillations.*—The frequencies of traveling waves may be very large, corresponding to the frequencies of the lightning discharge, that is to say, they are of the order of hundreds of thousands of cycles per second. If there were no damping effect they would travel with the velocity of light, about 188,000 miles per second. As the damping is very small, they move practically with this enormous velocity until the end of the line is reached, when they are reflected back on the line again, or partially reflected and broken up by choking coils, and so produce *standing waves.* That is to say, when a traveling wave is reflected, the combination of the incoming and reflected waves produces a standing wave or oscillation, that is, a wave in which the voltage has maximum and minimum values at fixed points on the line. In fact, the phenomenon of a standing wave is exactly similar to the oscillation of a vibrating string fixed at two ends, or to the oscillation of the air in an organ pipe.

When an impulse meets an obstruction, such as the choking coils at the entrance to a power station, it may happen that at some point the incoming and reflected waves neutralize each other and produce a point of minimum voltage; and, on the other hand, the waves may, at some point, add together and

produce a point of maximum voltage. When the potential of the traveling wave is at its maximum at the end of the line, the maximum voltage of the reflected wave is twice that of the incoming wave. In this way very high voltages, sufficient to puncture insulation and produce arcing generally, may be set up at the station.

The magnitude of standing wave disturbances is limited by the wave-length of the disturbance. The energy of a standing wave a mile long cannot be very great owing to the limited capacity and inductance of this length of line. Any circuit disturbance may produce oscillations containing only the very-high-frequency harmonics, and in this case is purely local, but it may become general throughout the system by including the lower and fundamental harmonics, and in this case it is known as a "surge." In this case, the power which oscillates is the generated power of the system, and the destructiveness of the oscillation is dependent upon the available generated power, and is independent of the power of the disturbance which primarily caused the oscillation. For this reason internal surging set up by external influences is very dangerous. The higher the frequency, the shorter the length of the line which oscillates, and the smaller the power and destructiveness of the oscillation. High-frequency oscillations, such as standing waves due to lightning discharge, are mainly dangerous then, owing to direct puncture of the insulation and to the liability of producing low-frequency surges.

The four types of disturbances which have been discussed may occur singly, in groups, or all may occur together or successively. A direct stroke and static charge, for instance, sets up a traveling wave. A traveling wave breaks up at the station into standing waves. A standing wave punctures the insulation and causes a short-circuit, which may produce, on rupturing itself, a high-power, low-frequency surge. A similar effect is produced by a static charge discharging to ground.

THE PROTECTION OF LINES FROM OVER-VOLTAGE.

Direct Strokes.—The only protection against the possibility of a direct discharge on to the line is the use of lightning conductors on each pole. If the poles are of metal the use of lightning rods becomes unnecessary. There is no doubt that the overhead guard wire, if properly earthed, affords a good method of protection, in that it acts as a lightning rod, *i. e.*, its action in this case is entirely preventive and not curative.

Static Charge.—The problem of dealing with static charge consists in designing a piece of apparatus which will continuously conduct away the charge and at the same time offer an enormous resistance to the line voltage. There are at least four well known methods of dealing with this trouble.

(1) The line may be earthed through a choking coil whose self-induction is regulated to carry, say, about 0.1 ampere of the line current. Such an apparatus constitutes a complete earth for static charge, without causing any serious disturbance to the system, and as the normal line current flowing through it to earth is very small, and at the same time wattless, the energy lost is also very small.

(2) Another method is to earth the line by means of a water-jet arrangement. In this the line is continually earthed by a jet of water sprayed upon it. This method is in extensive use in Europe, and answers its purpose very well, but at the same time at a power station where water is not in abundance the maintenance may prove expensive, and also the apparatus requires a fairly large space, and careful attention.

(3) There is also the gap-arrester method, whether of the horn or multi-gap type. It may be contended that gap arresters are not primarily intended for dealing with static phenomena, yet at the same time, if no other protective device is in commission, they have to serve as protection. The objection to this form of protection from static over-voltage lies in the fact that they do not conduct the static charge away continuously. The device only becomes operative when the static potential has risen to a value sufficiently high to jump the gap, and consequently the potential may have risen to a dangerous value before the device operates. Moreover, supposing the device operates safely, there is the trouble which may occur owing to the dynamic current of the line following the static discharge.

(4) Lastly, there is the method adopted of earthing the neutral, either of the generator itself, or of a transformer on the line side. Earthing the neutral of a generator is quite feasible, where the generator operates at line voltage, but the objection to this arrangement is the fact that it introduces the question of the third harmonic voltage which is one of the fundamental causes of induction in telephone lines. The second method of earthing the neutral is quite extensively carried out, and consists in having an idle transformer on the line, whose high-tension winding is starred and secondary winding meshed. Provided a sufficient number of transformers is distributed over the system, this method is probably the best, although undoubtedly the most expensive.

In grounding the neutral of a system, the greatest caution must be exercised, as there is also the danger of the short-circuit surge being developed through the occurrence of a fault on the line. Grounding the neutral on a system, in which an "arcing ground" has developed, would, of course, immediately convert the oscillating arc into a short-circuit arc, and so into a short-circuit surge. It is safe, however, to ground the neutral with a non-inductive resistance.

With resistance in the neutral there is no likelihood of a short-circuit surge developing, and an arc discharge to ground so dangerous to the system, immediately forms a dead short-circuit of a current which is limited by the resistance. The resistance should be made as high as possible, but at the same time, sufficiently low to allow enough current to operate the feeder switch, and so cut out the disabled feeder. Great care must be taken to make the resistance absolutely non-inductive, as any reactance in the neutral circuit would tend to increase the dangers of a surge, and consequently in all cases the resistance should take the form of a water tank. The water tank should be kept inclosed, so as to be free from contact with any matter which would tend to alter its resistance, and for safe operation the water resistance to earth should be periodically tested for standard value.

Impulses and Standing Waves.—For dealing with over-voltage due to the above phenomena, there are at present four well known devices on the market, the horn arrester, the multigap arrester, the aluminium arrester, and the Moscicki condenser. The fault of all arresters built on the gap principle is the trouble of extinguishing the arc after the arrester has operated. The arc once started is almost invariably followed by the dynamic current of the line which has then to be broken, and the mere fact

of rupturing the current has a tendency to create another over-voltage, and unless the resistance to ground is made sufficiently high this danger is always present. The multigap arrester is suitable only for low-power systems. This arrester allows a passage for a lightning discharge, limiting it somewhat, and ruptures the power arc, by means of non-arcing gaps, with considerable effect. The most promising type of arrester for high-tension, high-power systems is probably the aluminium arrester. Its principle and application are both ideal and simple, in that it provides a path to ground through which the normal line current cannot flow, while offering an easy path for lightning discharges. The objections to this arrester are: The electrolyte must be pure or the film will be easily punctured; the arrester must be kept cool, and must always be kept level to prevent the electrolyte from flowing over the edges of the plates; the electrolyte must not freeze as it becomes inoperative when frozen; it is difficult to insulate the series of plates at the edges. The Moscicki condenser is comparatively a new type of arrester, and has not as yet been in operation in this country, although there are a large number installed in Europe. In this type there are no horn gaps in the earth path, the line being connected dead to the earth through a series of condensers. The principle involved is one of capacity pure and simple, and its action is dependent on the fact that a high-frequency current prefers a capacity path to any other. Since the charging current of a condenser is proportioned to the frequency, it is clear then that a condenser placed between line and earth offers an easy path for a high-frequency over-voltage. At the line frequency the condenser is inoperative, and only operates when subjected to a high-frequency surge. It will thus be seen that as far as lightning discharges are concerned, in which the frequencies are usually very high, the principle is ideal, but as a protection against a low-frequency surge it is valueless. The great feature of this arrester is undoubtedly the fact that at no time during its operation does it allow the flow of the line current, and there is consequently no dynamic arc to break, and no fear of subsequent surging being produced.

The Overhead Grounded Wire.—It is quite obvious that complete protection from atmospheric phenomena can be obtained by putting the lines under the ground, but in cases where this is not possible an alternative is to put the ground over the line. In other words this is equivalent to using grounded overhead wires. It is well known that there is no electric force within a closed conductor, and the obvious method then is to completely surround the line in a metallic shield. While this is not easily obtainable in practice it is found that good protection is in most cases secured by placing a grounded wire above each phase of the line, provided the wires are of good conductivity and are grounded at as many places as possible. To make the protection as complete as possible the wire should be grounded at every pole and no expense should be spared in order to obtain a thorough and satisfactory ground. Capital expenditure on securing a good system of grounded wires is money efficiently spent. There can be no doubt that, if a system of installing grounded wires on either side as well as on top of the line were adopted, the extra expense would be justified by the better protective results obtained. The main objections to the use of grounded wires are the following: If, owing to a mechanical fault in the construction, the wires are not strung up strongly enough, they become loosened, with the result that contact with the line is probable, causing trouble. The initial cost of installing them is high, where good protection is necessary. However, there can be little doubt that an effective system of grounded wires affords more protection from atmospheric phenomena than any other piece of apparatus on the market.

Finally, the problem of protection from disturbances due to atmospheric phenomena is threefold.

(1) To guard against the entrance to the station of disturbances from the outside.

(2) To guard against disturbances creating other disturbances.

(3) To discharge to earth any disturbance easily and quickly.

Commercial Practice—Management, Rates, New Business.

House-Wiring Rates in Rockford.

The Rockford Electric Company, Rockford, Ill., under the management of F. H. Golding, has had exceptional success in the matter of wiring old residences for electric light. The following is a schedule of prices charged by the company for wiring a six-room house, including porch and bath:

Wiring	$18.00
Fixtures.	
Parlor (3 lights)	2.75
Dining Room (2 lights)	2.25
Bedroom (2 lights)	2.00
Kitchen (1 light)	1.00
Bath (1 light)	.80
Porch (1 light)	.65
Hanging and connecting	1.00

The total cost therefore, including all necessary fixtures, is $28.45, which amount the company allows to be paid monthly.

Galena Company Enters Schullsburg.

At a recent meeting the City Council of Schullsburg (Ill.), the Interstate Light & Power Company, Galena, Ill., was granted a twenty-five-year franchise to conduct a light and power business in that town. One of the most enthusiastic workers for the franchise was the Mayor of Schullsburg, who immediately signed a ten-year contract with the company for city pumping and street lighting. The latter contract provides for a minimum of sixty sixty-watt tungsten lamps.

At present the Interstate Company's transmission lines terminate one mile from Schullsburg, but extensions will immediately be made. This case shows the value of electric supply from large stations to adjoining towns.

Closes Large Power Contract.

The Appalachian Power Company, one of the properties which H. M. Byllesby & Company has recently acquired, has entered into a contract with the Roanoke Railway & Electric Company for the sale of electric power to be developed at the hydroelectric plant now under construction on the New River, sixty-five miles distant. The contract extends for a period of twenty years and provides for a minimum annual payment to the Appalachian Power Company of $32,000. The contract stipulates that all of the electric current distributed by the purchasing company in Roanoke, except that which may be developed by a local water-power project, shall be purchased from the Appalachian company.

Electric Cooking in Kalispell.

The Northern Idaho & Montana Power Company reports that electric cooking is making remarkable strides in Kalispell, Mont. At the recent County Fair the company distributed electrically cooked food to all visitors and in addition loaned electric ranges to all lunch stands on the grounds. As a result the company obtained the names of fifty prospects who desired more information regarding the range and who gave more than usual assurance that they desired to purchase. There are already seven electric ranges in Kalispell.

Development of Power Business by a Small Central Station.

What may be accomplished by the small central station which makes a consistent effort to secure power business is well illustrated by the power load of the Maryville (Mo.) Light & Power Company. This company inaugurated twenty-four-hour service only a few months ago, and at present is enjoying a motor load aggregating 286 horsepower.

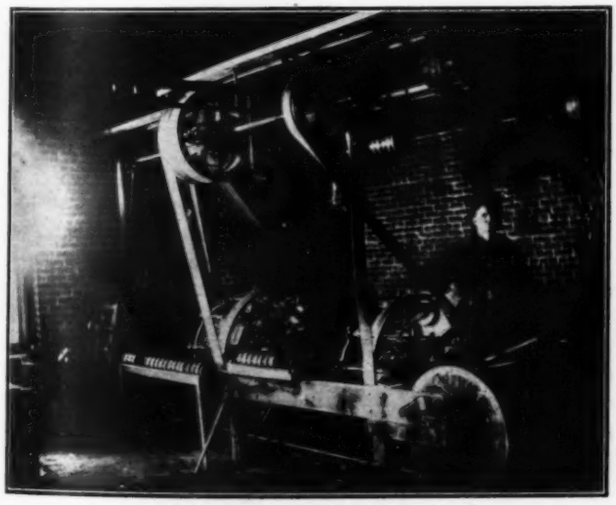
As regards industrial plants, the company was limited to the steam laundry and a lightning-rod factory, these being the only industries in the town. Both plants were secured, however, the laundry installation being made on the proposition that the laundry pay for same out of the saving of the motors over the replaced steam engine. A four-cent rate was made, the power bills averaging about $40 per month. This is a saving of practically $20 per month.

In the lightning-rod factory twenty-six horsepower in motors were installed, these comprising two three-horsepower and four five-horsepower motors. One of the accompanying illustrations show a two-horsepower motor operating a cable machine in this plant.

A considerable portion of the Maryville Company's power business is obtained from neighboring farmers. A particularly noteworthy installation is on the Craig farm, about two miles from the central station, where a twenty-two-horsepower motor operates a feed mill.

MOTOR DRIVING ELEVATOR GEARING.

Another farm installation is on the Charles Bellows stock farm, located about two miles from the station. Here there is a twenty-horsepower motor running a corn sheller and grinder. As noted in one of the illustrations, this motor is mounted on skids together with the starting box so that same can be drawn by team to any point on the farm for cutting hay, filling silos, and other farm service.



MOTOR OPERATING CABLE MACHINE.

MOTOR OPERATING CORN SHELLER.

NEW-BUSINESS METHODS FOR THE SMALL CENTRAL STATION.[1]

BY ARTHUR GUNN.

In every company, the new-business getting is so closely connected with other departments of the business, and particularly so in the small station where the entire management devolves on one man, that it is impossible to discuss the methods in this department, without incidentally touching on some features which might be considered to lie outside of the subject.

By a "small" central station we may consider as defined the company which is too small to have an executive staff. and where the responsibilities of all departments rest upon one man as manager. One advantage at least can be said to pertain to this arrangement—all departments are in close relation and harmony with each other. Such a manager does not have to contend with departmental indifference and jealousy which is often a serious factor of trouble in larger companies.

"The man behind the gun" is an essential element in this as every human problem. Let us first take stock of our manager. He must be a man of excellence in many characteristics, for to succeed he must show ability in many directions. The man who has the essential characteristics to make a really successful manager for a small central station is the best possible timber for manager of a large one—and to that position he may well aspire to attain, either

1 Abstract of a paper presented before the Northwest Electric Light and Power Association, at Spokane, Wash.

through the development of his small company into a large one, or from opportunities arising from the notable character of his work. Successful managers of small plants are not so numerous as to be individually inconspicuous from their number.

I would name as the essential characteristics of such a man: Dissatisfaction, ambition, intelligence, information, industry, tact, perseverance, courage and common sense. He must be perpetually dissatisfied with what he is and what he has accomplished—he must not "get stuck on himself." He must have ambition for greater and better things. He must have intelligence, and must have, or obtain, information. It seems almost a jest to say that the man with so many things to do should be industrious, but in this connection we are reminded of the witty preacher's definition of a lazy man as "The fellow who spends so much time doing what he wants, that he has no time for doing what he ought." And finally in dealing with his consumers, actual and prospective, he certainly will need tact, perseverance, courage and common sense.

Now let us take the case of the average small central station, in which one man is manager, superintendent, sales agent, and perhaps lineman and station operator. We will assume that this man is fairly qualified for his position, that is, that he has a fair working knowledge of the business. How can he best increase the business of the company?

First. He must bend his energies to giving satisfactory service. The customer of an electric light and power plant is paying his money in the expectation of receiving a certain definite commodity. That commodity is electric energy to be delivered continuously for certain hours during each twenty-four, at an agreed voltage, and within agreed limits as to quantity. Uninterrupted service and regular voltage are essential. While operation does not properly come under the head of "New Business," "New-Business" success is so dependent upon it, that we are justified in mentioning it. The manager of the small plant will keep his lines and generating station in the best operating condition and efficiency of operation that faithful effort and the means at his command will allow. He will take care of all trouble as promptly as possible. A consumer left in the dark for a single night through the fault or negligence of the company never feels that any credit is due the company for the service furnished for the rest of the year. Meter reading and testing have an important bearing on the relations between the company and the consumer. A discourteous meter reader can make more trouble for the company in one month than an accommodating manager can straighten out in six. Too much care cannot be taken in handling complaints. A complaint properly handled to the satisfaction of the consumer will do as much toward getting new business for the company as any other method which the company may employ.

Too many managers of plants big and little appear to assume that in furnishing service to their customers they are conferring a favor, and are dictatorial and even rude in their treatment of them. The true statement is that he is giving value for value received, and his motto should be "Charge what the service is worth, and deliver all that the customer pays for." If he is convinced that his rates are fair, and proportioned to the cost of service, he has nothing to apologize for and should never allow himself to be put upon the defensive or in an apologetic attitude. But he should remember that the difference between a large consumer and a small one is a difference in quantity and not in quality, and that his duty to each is equally great. Every customer is entitled to be treated as courteously as though he were the most important patron which the company had, and that it was absolutely necessary that the company should have his business.

The successful new-business man will constantly live in the atmosphere of his work. He will rise with it, stay with it, go to bed with it and sleep with it. To illustrate: The manager in a town of a thousand people, who has been very successful, writes: "I know of no special methods of getting business in a small town only to put in every minute working. On my way to and from work I call on prospectives. I also do soliciting right along with my wiring work. Sometimes I take men and tools and materials right up to a house; estimate and wire it. I have gotten the very hardest ones to come through by this method, as there seems to be a sensitiveness about being passed up for the next neighbor." This man certainly lives in the atmosphere of his business, and exhibits well directed energy and a keen judgment of human nature as well.

Of the uses of electric energy there are no end. The electric iron has become almost universal—electric cooking devices are plentiful. Power applications are limited only by the ingenuity of the new-business man and the size of the field. Electric soldering irons, glue-melting pots, vulcanizers, heating pads, milk warmers, fans, and other apparatus can be put out in even the smallest communities. We give a few points which have been furnished us by various managers. One writes: "Upon fitting out a house and turning on the lights, I call in the neighbors to inspect it. The people whom I have just lighted are more enthusiastic at this time than any other and will do more to help me to secure business than at any other time. Unless I sell an iron and a toaster outright I place them on trial for thirty days. I advertise the cost per hour to operate the different appliances so there can be no misunderstanding. I try to keep everybody satisfied, because in a small town a good knocker can go the rounds in a very short time."

Another furnishes a good "don't" hint. "I never place an electric device which is an excessive current eater in the hands of a customer who is liable to fail to understand in advance the apparently excessive bills which will naturally follow the installation of such a device."

Seek to build up your business upon lines already constructed, rather than to spread out too fast in new construction. Work to the end of having every house and building reached by your lines connected, and the maximum economical use of electric energy at each location, rather than a widespread system with sparse connections.

For the rural town, investigate the possibility of the country line. The farmer's telephone lines have covered the country, and the farmer's electric lines should follow them. Many farmers will advance the cost of construction, part or all of which may be returned to them by applying it upon their bills. Farmers are liberal power users when convinced of its practicability and economy.

In working up business in a new locality or extension, avoid holding public meetings—work man to man. However enthusiastic a meeting may appear to be, it is usually, consciously or unconsciously, hostile to the man who has a scheme to present.

Electric Lighting and Illuminating Engineering

SOME OPERATING CHARACTERISTICS OF METAL-FILAMENT LAMPS.

BY J. FRANK MARTIN.

During the latter part of 1908, when the introduction of commercially practical metal-filament lamps was creating considerable attention, the writer made the prediction that it was probable that a too rapid introduction of these lamps would cause a noticeable falling off in central-station loads, especially those stations having a proportionately large lighting load.

After about three years this opinion is confirmed by actual conditions and records, although the effect has not been so noticeable as was expected on account of certain limitations in the manufacturers' output, caused by the development of improved methods of manufacture and a better product, all

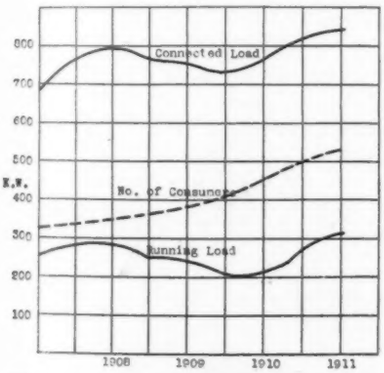


FIG. 1.—LOAD VARIATION CAUSED BY METAL LAMPS.

of which has led to a gradual reduction totaling about fifty per cent from a maximum price.

The actual effect of the introduction of metal-filament lamps in two small cities is shown in Figs. 1 and 2. The period covered by the curves shown is four years, preceding by one year the time that the introduction of this type of lamp was started. It is shown that the output gradually began to fall off with the introduction of these lamps. The connected load naturally falls off also, but, in every case, it was found that the falling off in connected load was in a great deal less proportion than the falling off in running load or output. This is accounted for by the fact that the number of consumers began to increase more rapidly as soon as the new lamp was available. More and smaller consumers were attracted by its increased economy.

The most vital effect is not shown in these curves, that is, an increase in

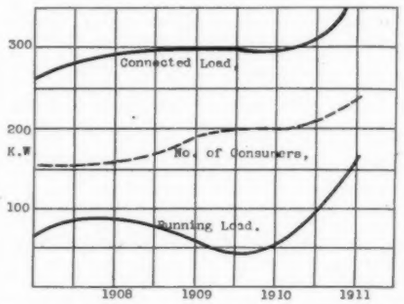


FIG. 2.—LOAD VARIATION OF A CENTRAL STATION.

the cost of supplying service occurs whenever there is an increase in the number of consumers without proportionate increase in the running load. In the above curves it is shown that the total running load decreased thirty-four per cent, the total connected load six per cent, although the number of consumers was steadily increasing. The actual increase in the cost of supplying service was about nine per cent, and does not bear a very close relation to reduction in running and connected loads, but is sufficient to show that there has been a considerable reduction in the revenue and that central stations having a comparatively large lighting load have felt the effect worse.

The above leads to the conclusion that the objectionable effects of the introduction of metal-filament lamps can be considered as a condition of the past. The new lamp should and in many cases is increasing central-station revenue. If properly handled it will promote more intensive development of lighting loads. It will make electric lighting more universal because it makes electric lighting more economical, and very attractive to the small consumer who in the past has preferred to avoid the use of electric current.

From a strictly operating standpoint there are other effects. The most important appears to be the phenomenon of overshooting of current at the instant the lamp is switched on. Fig. 3 shows the performance of a 100-watt, 110-volt lamp.

The first objectionable condition arising from this performance is the effect on circuit-breakers protecting circuits having a large part or all the load in this type of lamp. A straight overload release breaker invariably opens when the circuit is thrown in on normal full load or when switching occurs ahead of the circuit-breaker, and it is difficult to close the breaker unless the tripping devices are made temporarily inactive. A tripping device having a small time-limit feature or some modification of this scheme, offers a solution of this situation, but is liable to impose conditions which

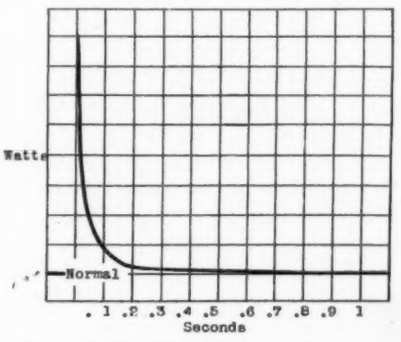


FIG. 3.—OVERSHOOTING OF 100-WATT 110-VOLT MAZDA LAMP.

mean radical changes in the present circuit-breaker practice; in other words, "the cart is put before the horse," when these devices are placed at the point where a load is delivered.

Due to the relatively large safety factor and time element on fuses of every description, no trouble can originate on circuits so protected.

Overshooting of the light from metal-filament lamps also occurs coincidently with the current impulse at the instant the lamp is switched on. This has made the Mazda lamp particularly desirable for use in flashing signs and

has added effectiveness to sign installations on which imitations of mechanical movements are used. This overshooting of light, together with the very rapid cooling effect, allows exceedingly rapid flashes.

Overshooting of current may effect alternating-current meters in two ways, first the rush of current imposes an overload, or rather an impulse of current having overload dimensions, on the meter. This overload creates stray alternating-current fields which cut the permanent braking magnets and this may in time weaken these magnets so that the meter will run fast. The second effect is an error in the registration of meters due to the inertia of the moving element on very rapid load variations. In Fig. 4 is shown the relative consumption of two signs, one employing tungsten lamps and the other

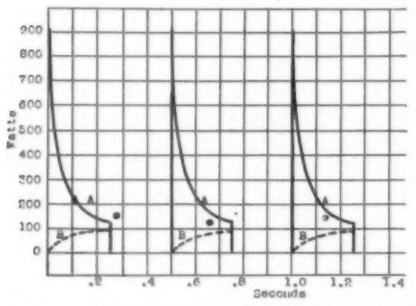


FIG. 4.—COMPARATIVE CONSUMPTION OF TUNGSTEN AND CARBON LAMPS ON FLASHING SIGN.

carbon lamps. The rating of the lamps is the same in each case and both are operated at 120 flashes per minute. Curve A represents the consumption of the tungsten lamps, B that of the carbon lamps. The actual consumption of the two signs having exactly the same rating can be found by intergrating these curves, which are plotted in watts against seconds. The total consumption of the signs per second is 65 watt-seconds when using tungsten lamps and is 18.5 watt-seconds when using carbon lamps. The meter registration would be approximately 19 watt-seconds with tungsten lamps and 11 watt-seconds using carbon lamps.

When employing flashes slower than twenty per minute the error in meter registration becomes negligible. On a large sign divided into sections, each section flashed at different intervals or in periods which are not coincident, the meter registers accurately since the resultant of the many impulses assumes a fairly straight line and the load is nearly constant. The only effect present on such a sign is a consumption exceeding the total rating of the lamps. One large sign investigated had a load of 400 five-watt lamps working at normal voltage and 180 flashes per minute, and had a consumption of 2,760 watts or 1.38 times the rated consumption of the lamps.

Direct-Indirect Lighting for Art Galleries.

In an interesting article dealing with natural and artificial lighting of art galleries, Putnam A. Bates points out in the *Scientific American* the requirements for the proper illumination of pictures and how these may be met by both natural and artificial light. For the former he recommends a prism-shaped monitor skylight with opaque top and inclined, diffusing, glass sides, thus throwing the light upon the walls through a diffusing, central, ceiling skylight. For artificial lighting he recommends that incandescent lamps be mounted with concentrating, opaque, mirror reflectors between the two skylights so as to direct the light uniformly onto the walls. Such an installation was designed by Mr. Bates for the Morgan Memorial Building, Hartford, Conn. It was described in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of August 6 and September 10, 1910.

Indirect Lighting Not Shadowless.

The claim frequently made by the opponents of indirect lighting that it produces a monotonous and shadowless illumination is effectively disproved by a photograph of a sculptor's studio reproduced in the October number of the *Illuminating Engineer*, London. The room was illuminated by an inverted arc lamp beneath which were symmetrically suspended side by side a flat circular disk and a sphere of the same diameter. The lower portion of the latter shows a marked shadow effect which clearly identifies its form and makes a decided contrast to the uniform illumination on the adjoining disk. Beneath these objects is a statue that displays excellent light and shadow effects, in fact, these are not so harsh as in many cases of direct lighting.

Wireless in Cochin China.

Saigon, in Cochin China, is to have a wireless station, with four masts, each 250 feet high. The energy required will be forty kilowatts, giving a range of 2,500 miles.

Neon Tubes as Illuminants.

George Claude has conducted a large number of experiments in France aiming at the perfection of neon tubes for illumination. Their form is not unlike that of Moore tubes, but they contain the recently discovered neon gas, instead of nitrogen or carbon dioxide as utilized in the Moore system. Mr. Claude also attempted to eliminate the need of an automatic valve, which is a requisite of Moore tubes. In his early tests he found that the electrodes volatilized rapidly. By increasing their size he finds that this trouble is almost entirely overcome. In some tubes installed at the Grand Palais the electrodes were copper cylinders having a surface area of three square decimeters per ampere; the outer diameter of the tube was 45 millimeters and the length 35 meters (115 feet). One of these tubes had a life of 210 hours, when it was accidentally broken. More recently by still further increasing the electrode area to five square decimeters per ampere excellent results have been attained in compact tubes. A twenty-foot tube of this type has shown practically no change after 400 hours aside from a decrease in potential difference at terminals of about four per cent. Tubes of this length are now believed to be commercially feasible both from the manufacturing and utilization standpoint. Their light is of a pleasing orange-red color. The efficiency is exceptionally good, being given as 0.4 watt per candlepower.

Electric Light for Hindu Temple.

Electricity has scored its latest triumph in the shape of the blessing of the Brahmans. Famous Hindu pundits have sat in solemn conclave at Calcutta to determine whether the sanctity of the famous Temple of Kali would be imperiled by the introduction therein of electric light, and after numerous sessions, during which with scholarly thoroughness the whole question was debated from every point of view, pundits and priests have decided with complete unanimity that the irons will carry with them no contaminating influence. So Kali-Ma, oldest and most potent of goddesses in the Hindu Pantheon, will in future be worshiped in the light of the twentieth century, and the mysterious twilight in which she has dwelt for so many centuries will be dissipated by metal-filament lamps. —*Electrical Engineer.*

Telephony · Telegraphy and Wireless

The Compressed-Air Plant in the Hamburg Telephone Exchange.

The large central telephone exchange in Hamburg had considerable trouble with the testing of underground telephone cables and the cleaning and dusting of switchboards, jacks, cords, etc., and it was finally decided to install a compressed-air plant for this work, as experiences in other German cities had showed the economy of such a step.

The machinery for furnishing the compressed air is installed on the basement floor in the center of the exchange. The plant consists of a ten-horsepower shunt-wound motor, a compressor and an air vessel in which the compressed air is cooled and freed of oil before entering the cables in the conduits. The cables terminate at the compressed-air plant and run in various directions through the cable conduits. Compressed-air pipes run from the plant through the building for cleaning purposes. The electric motor drives through a belt the double-acting single-cylinder compressor running at 220 revolutions per minute. The cylinder diameter of the compressor is six inches and the piston stroke is six inches, giving the machine a capacity of 43 cubic feet of air per minute. If the pressure in the air vessel connected to the compressor rises above 4.2 atmospheres, the compressor runs without action and later begins to compress air again when the pressure in the air vessel has decreased by 0.4 atmosphere. The automatic starting and stopping of the compressor is accomplished by an air-pressure regulator, which helps a great deal in keeping the operating cost of the plant within low limits, especially when the demand for compressed air is slight.

The compressed air contains two undesirable impurities, oil and water, which must be removed before the air can be used for cable testing. When compressing the air to 4.2 atmospheres it is heated considerably, and some of the lubricating oil in the cylinder is carried over with the compressed air. To separate the moisture drawn in by the compressor from the air, as also the oil, the compressed air is first cooled in the air vessel, whose lower portion is water cooled by means of copper coils. Then the air enters another compartment where the oil condenses. To dry the air completely, it is passed over calcium chloride, which, being a hygroscopic substance, withdraws all moisture from the air.

When using the purified air for cleaning purposes, compressed-air hose is attached to the valves in the various halls and rooms and air admitted. Three systems are used in this connection; compressed-air blast to blow the dust away; suction apparatus to draw up the dust; a combination of both. As these appliances have much similarity to the well-known compressed-air and vacuum cleaning systems in our own cities, it is not necessary to dwell on this subject longer, and we can therefore consider the cable-testing part at once.

The paper-insulated cables in the Hamburg telephone system have at a distance of about 100 feet from the exchange a soldered joint with a threaded cock, which communicates with the interior of the cable and is closed by an air-tight screw cap. If the cable is to be tested, the cap is removed, a threaded T-union with a manometer on one end and the connection to the compressed-air hose on the other end, is screwed over the cock. A simple threaded union, with a manometer on top is screwed on a similar cock at the other end of the cable section which is being tested. If the cable is sound, the manometer at the further end away from the exchange will show an increase of pressure due to the inflow of compressed air. The time necessary for the final manometer reading depends upon the air pressure, the cable length, and the insulation around the conductors. If the paper insulation is thickly and tightly wound it will offer a greater resistance to the air than otherwise. As long as the paper is dry, however, this will not make much difference. As a rule the reducing valve at the plant will allow the nearest manometer to read 3 atmospheres pressure, and the further manometer should then read 0.5 atmosphere, after two and one-half hours testing in a cable 1.55 miles long. After several tests a record can be kept of the different cable lengths, permitting a quicker determination of the soundness of the same. Care must be taken to have all connections airtight so as to avoid errors. If the second manometer should show no increase of pressure or only a very slight increase, the cable sheath has a leak at some point and steps must be taken to locate this. In long cable lengths it has been the practice in Hamburg to drill into the cable every 0.6 of a mile, insert cocks and manometers, and solder the places again after testing. A longer test can be made by inclosing compressed air within a cable section and leaving it there for several days. If, after that time, the manometers still show a relatively correct pressure the cable is sound. Smaller or larger cracks in the lead sheath can be located by listening for the hissing sound with which the air escapes through the leaks and by passing a lighted candle along the cable length, the escaping air either making the candle flutter or extinguishing it. To close leaks and cracks, the Hamburg exchange uses an easily fused colophonian soldering tin of special composition which has given excellent results.

This testing equipment has proved a valuable asset to the Hamburg exchange and has saved a considerable amount of money. Where water had entered conduits and soaked the cable insulation, compressed air was used to force out the water, whereupon the paper could be laid bare, dried, and the cable repaired without the expense of connecting a new cable section. One instance may be cited to illustrate the point.

In one case water had flooded the conduits for a stretch of 50 feet, at a distance of 0.6 mile from the exchange. The 250-pair cable was dried continually for 50 hours, and 36 hours after this it was again in operating condition. The cost of drying this ca-

ble was $21.05, while a new cable section, which would have been necessary if the compressed air had not been available, would have cost $540, including connecting.

The final feature worth considering is the installation and operating cost of the plant. The total initial cost of this plant amounts to $2,792, distributed as follows:

a. Compressing and air-purifying equipment at the exchange (motor, starter, switchboard, compressor, air vessel, piping, etc.)	$1,125
b. Equipment for cleaning and dusting, suction apparatus, vacuum cleaners, hose, etc...	825
c. Testing and drying equipment for cables, manometers, compressed-air cables, etc.....	842
Total	$2,792

The plant is used about 3,000 hours a year on the average.

As regards operating cost, the care of the compressor plant can be omitted, as the work is done by the regular staff in the exchange engine room and entails no extra expenditures. The wages for the helpers for dusting and cleaning are about $462 per year, and for the men testing the cables about $682. The expense for material used in cleaning and testing, as solder, etc., is nine cents per hour, equal to $270 per year of 3,000 hours, of which $160 is for cleaning and $110 for cable drying and testing.

Allowing fifteen per cent for interest and depreciation, by setting apart $210 for each service, we have a total of:

A. Fixed and operating expenses for cleaning and dusting....	$ 832
B. Fixed and operating expenses for cable testing and drying.	1,002
Total annual charges.....	$1,834

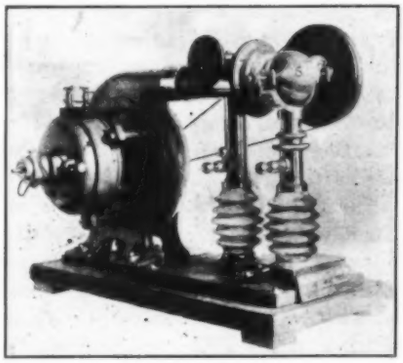
While this sum may seem high in itself, it has saved many thousands of dollars and valuable time in locating and correcting leaks and faults in cables, especially in drying cables that were put out of commission by sudden flooding of conduits or other similar causes.

Wireless Corps at Cornell University.

A wireless telegraph detachment of sixteen men will be formed in the signal corps of the Cornell University cadet battalion. Preparations will be made for the use of wireless in the battalion maneuvers, which will be held next spring.

A New Spark Gap.

A new form of spark gap for wireless telegraphy was described recently before the Société des Electriciens in Paris by Ducretet and Roger. It has several novel points, and is designed so as to produce sparks under the best conditions to obtain strong and regular electric oscillations, and in this way to increase the effective output of a plant of this kind. The two poles of a spark gap often become unduly heated and roughened, and this gives rise to irregular action. Different methods have been brought out to overcome this drawback, such as making the spark pass in a magnetic field or in an insulating oil bath. An air blast is another means which is frequently used, and we also find various kinds of revolving electrodes in use. The present apparatus combines some of these features. Sparks which produce a musical note are now coming



SPARK GAP.

into use, but here it is necessary to use high frequencies and reduce the wave-length or to make use of high-frequency alternators.

The present spark gap gives a strong cooling of the electrodes and avoids the retention of arcs. As will be noticed, one electrode is of spherical shape and revolves upon a pivot support. Next it and on the inner side is a thick metal cylinder whose end is well rounded and lies close to the sphere, so that sparks can pass between them. These two electrodes are solidly mounted on insulating supports provided with porcelain bases, and the connections to the electrodes are made by the binding posts. The metal ball is rotated rapidly by means of a small electric motor and pulley, and at the same time the motor drives a fan so as to deliver a strong draft through the narrow space between the cylinder and sphere. The cylinder is also rotated by means of a friction collar, which bears on the inner face of the pulley, and thus the ball and the cylinder turn in directions which are perpendicular to each other.

Thus the spark always passes between constantly cooled and renewed surfaces and is subdivided into a series which are distributed over all parts of the surface. In this way the active surfaces keep quite cool, and in the case where high frequencies are used there is obtained a very clear musical note, which can be readily perceived at a distance. Such a musical note can be varied within limits by changing the length of the spark by means of a rack adjustment. The sphere can be centered by the use of the sliding support and adjustment screws.

Telegrams By Telephone.

Considerable space is devoted in the *New York Telephone Review* for September to the new arrangements between the Bell Telephone Companies and the Western Union Telegraph Company, by which patrons of the New York Telephone Company may telephone their telegrams, night letters, day letters and cable messages to Western Union offices for transmission and have the charges billed on their telephone bills, and by which, also, telegrams are delivered to telephone subscribers by the Western Union over the telephone wires. By this arrangement the sending and receiving of telegrams, day and night letters and cable messages is made as simple as the sending and receiving of ordinary telephone calls.

The advantages of this new arrangement are not confined to subscribers, however, for under the new arrangement "every telephone is a telegraph office," and telegraph messages may be sent from public telephones and coin boxes wherever they are located.

The billing arrangement is one of the features which is most appreciated by telephone subscribers, for credit is extended to them by the telegraph company for all messages they may want to send and the inconvenience of ascertaining the exact cost of the telegram and making the change every time one wants to send a message is obviated.

Test of Reinforced-Concrete Pole.

A test of a reinforced-concrete pole carried out at Fulham, England, was reported in a recent issue of *Engineering*. The length of the pole over all was 44 feet 6 inches, of square hollow section, 17 inches square outside at the base, and 13 inches square inside at the same point, while the outside and inside dimensions at the top were 8 and 4 inches respectively. The reinforcement consisted of high-tension steel wires three-sixteenths inch in diameter, having an ultimate tensile strength of from 80,000 to 85,000 pounds per square inch, 56 being assembled together at each corner. These wires were held together by mild-steel tie-plates eleven-sixteenths by one-sixteenth inch pitched about two-foot centers. No binding wires whatever were used in the construction of the reinforcement. The pole was firmly imbedded in concrete for 5.5 feet, and the load was applied 38.5 feet above the top of the concrete foundation. The method of testing was by attaching a wire rope to a clip at the top of the pole, the rope being carried over a pulley sheave on a crane-jib at approximately the same level as the top of the pole, and the wire was led from the sheave down to within about 10 feet of the ground, and a spring balance was attached to it there. A chain was then fixed to the balance and wound round the drum of a crab-winch. A slight hair crack was observed on the tension side about 5.5 feet above the surface of the foundation, when the load was 3,350 pounds, and, when the load was increased to 3,600, slight hair cracks appeared, pitched regularly about 6 to 9 inches apart. At 4,100 pounds a slight shear crack appeared, starting about 33 inches above the foundation and extending vertically upwards. At 4,600, hair cracks occurred on the tension side regularly every 3 or 4 inches, and at 5,100, cracks were noticed to be traveling across the sides of the pole to within 6 inches of the compression side. At 6,100 the shear crack was more pronounced, and hair cracks on the tension side occurred, pitched about one inch apart, but no signs of failure were observed on the compression side at this load. After each of the tests the load was released and the permanent set was recorded. The total deflection at 3,100 was 16.5 inches, with a permanent set of one-half inch on release. The deflection was 37.5 inches at 6,000, when the permanent set was eleven-sixteenths inch, measured 1.5 hours after the load was released. On continuing the test, at 6,100 the shear crack was more pronounced. At 9,400 the pole had a deflection of 66 inches, and the cracks on the tension side were more pronounced. There were, however, no signs of failure on the compression side. On the load being released the permanent set was found to be 21 inches. The load was again applied, and the first signs of failure on the compression side were noticed when the deflection was 72 inches; complete failure occurring when the deflection reached 78 inches. It was found that the pole had failed almost equally for the whole of its length both on the tension side and the shear sides. On the compression side the pole showed no signs of failure, except at the base, to about two feet up. The total bending moment at the base of the pole was 4,863,936 inches-pound. It may be mentioned that when the load was 5,712 pounds, with 34-inch deflection, the chain on the drum of the winch broke, releasing the pole suddenly. The pole flew back, and, after vibrating violently for a few seconds, regained its normal position, and on examination it was found that no permanent set was indicated.

Growth of Telephone Service in Japan.

The telephone business of Japan is in charge of the Imperial Japanese Government, and there are no private commercial lines. Although the telephone business is increasing rapidly in Japan, it is the intention of the authorities to double the present equipment inside of the next six years. The rapid increase in this business is shown by the following figures, which do not include automatic call boxes:

Years.	Station and Offices.	Subscribers.
1906.....	334	43,266
1907.....	524	58,626
1908.....	997	78,517
1909.....	1,415	102,626
1910.....	2,233	126,720

The present telephone equipment, while giving nominal satisfaction, is, as a matter of fact, utterly inadequate in many instances. To secure a new telephone in Yokohama much annoying delay is met with. An applicant must wait for months before having his request attended to. As a result, high prices are frequently paid for a telephone connection when a subscriber is ready to part with its use. There are no towns in Japan of over 10,000 population that do not have a telephone service.

Wireless Service Around the British Isles.

According to the *Post Office Electrical Engineers' Journal*, formal approval has been given to a scheme for extending the service of coast stations for communication with ships at sea round the British Isles, and something like a complete scheme of wireless service with the object of affording to ships anywhere within 100 miles of the British coasts facilities for communicating with the shore and thence with the land telegraph system is involved. An additional station is to be erected on the west coast of Ireland for taking traffic from large Atlantic liners, and while opening up a new tract of ocean for wireless business this will relieve the existing station at Crookhaven, where wireless communication is rapidly becoming congested. It is also intended to erect at or near St. Just in Cornwall a well-equipped station capable of commanding traffic with ships entering or leaving the English Channel; this station will replace that now existing at the Lizard, and will also render the Bolt Head station of subsidiary importance except for emergencies. It will further command the Irish Sea and Bristol Channel. The Niton station is to be remodeled and rebuilt, probably on a new site near St. Catherines Point, and the existing station at Rosslare will be replaced by a more powerful installation at Fishguard. The port of Newcastle is also to be cared for by the post office, and the station at Malin Head, on the north coast of Ireland, is to be replaced by a more modern and powerful station in the same neighborhood.

Spanish Wireless Service.

The National Wireless Telegraph Company, of Madrid, has been granted the concession for establishing wireless telegraph service in Spain and the adjacent islands. Four stations have already been erected and four others are under way or planned. The Marconi system is used.

Telephone Train Dispatching on the Grand Trunk.

The Grand Trunk Railway has had two telephone circuits for train dispatching on trial for several months with such satisfaction that the system is to be extended over its entire line. The cost of the change will approximate $500,000.

Industrial Power

Towing Locomotives for the Panama Canal.

According to an article appearing in *The Canal Record* specifications have been forwarded to Washington for electric locomotives which are to be used for towing vessels through the Gatun, Pedro Miguel, and Miraflores locks. Bids will be asked on forty locomotives, though this proposal will be divided in two parts. One bid calls for one locomotive, while a second bid is to be made on the remaining thirty-nine in case the tests made on the first prove it to be suitable.

The system of towing provides for the passing through the locks of a ship at the rate of two miles an hour, the vessel being held steady between four lines of taut hawsers. A ship will come to a full stop in the forebay of the locks, where four hawsers will be attached to it, two forward on either side and two aft. At their other ends, these hawsers will be attached to the windlasses of four towing locomotives, operating on the lock walls, two forward towing, and two aft being towed by their hawsers, thus holding the ship steady.

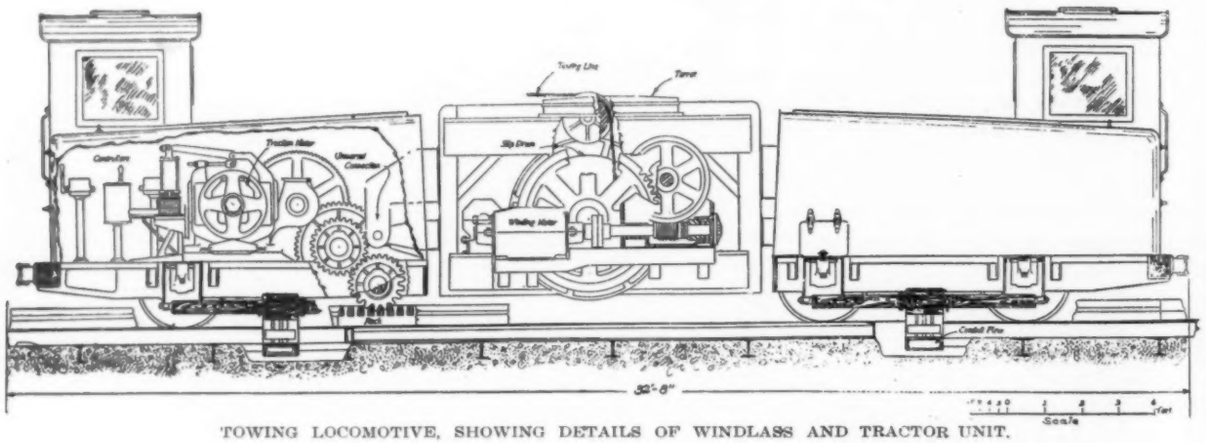
There are to be two systems of track, one for towing and the other for return. The towing track will be provided with a rack throughout its entire length, and while towing, the locomotive will always operate on this rack.

Each locomotive will consist of three parts, as shown by the drawings reproduced here—two tractors, and between them, a windlass. The windlass will not be mounted upon a truck, but will be supported by two arms extending on each side from either end and resting on bearings immediately over the rear wheels of the tractors. The ends of these arms will be equipped with rollers to permit free horizontal movement of the members when the locomotive is rounding a curve. The windlass is joined to the tractors by a drawbar and trunnion, which have the effect of a universal joint.

The tractors will be alike in every particular, each consisting of a four-wheel truck upon which is mounted a motor and control apparatus. The locomotive may be operated from either cab, and run as a friction or rack locomotive at the will of the operator. Motion is communicated to the rack pinions by a system of gears in which there are no clutches. As there is no method of disconnecting this train of gears the rack pinions can move only with the motors. A solenoid brake, which closes upon a brake wheel whenever current is cut off from the motors, provides against accident in case current should be cut off when the locomotive is on an incline. In such case the locomotive would stop instantly and be held until the brake is released. The rack pinions are of quill construction and are mounted on the back axle of each truck.

For traveling by friction, the tractors will be fitted with jaw clutches, which will connect the traction motors with the driving wheels. These clutches will be operated by solenoids. The locomotive, when operating by friction, will move at a rate of five miles an hour.

The electrical equipment for each tractor will consist of one traction motor with control apparatus. The motor will have a full-speed torque of 840 pounds at one foot radius, full-load speed at no less than 470 revolutions per minute, and will be capable of developing not less than seventy-five per cent greater torque for a period of one minute. Alternating current will be used with the effect that synchronous speed will be maintained on all the locomotives in a tow. The motor will be three-phase, induction, totally inclosed, moisture proof, high torque, or mill type, twenty-five cycles per second, with 220 volts between lines. The motors on the tractors of each locomotive will be operated in parallel, and controlled by resistance in the secondary circuit, accomplished by contactors in the primary and secondary circuits operated by master controllers, one in each cab. There will be not less than seven power points in each direction and between these and the braking position, there will be a coasting point, so that when power is turned off from either forward or reverse direction, there will be available a coasting point before the braking position is reached. The master controllers will be of the drum type, one for each tractor.

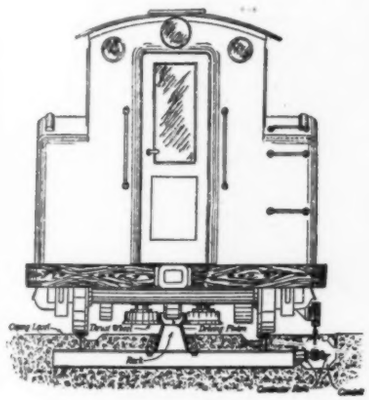


TOWING LOCOMOTIVE, SHOWING DETAILS OF WINDLASS AND TRACTOR UNIT.

Current will be supplied to each tractor by means of a plow carrying two contact shoes, each operating on a separate power rail carried in an open conduit, one for each of two phases, while the third phase willl be carried by both track rails.

As weight is not required for tractive effort the whole locomotive may be of as light construction as possible, the estimate being 70,000 pounds.

The windlass for paying out and hauling in cable will be provided with two speeds, one for hauling in line without load, and the other for operation with a boat in tow. A friction clutch will provide against sustaining a load of over 25,000 pounds. Rotary switches in the cabs will control the movement of the windlasses. Two motors will be provided, one for turning the windlass at high speed with light load and the other for turning at a slow speed with a heavy load. The latter—the windlass motor—will have a full-speed torque of 120



END VIEW OF LOCOMOTIVE.

pounds at one foot radius, will be capable of fifty-per-cent greater torque for one minute, and will have a full-load speed of not less than 630 revolutions per minute. The coiling motor will have thirty pounds torque at one foot radius, be capable of exerting fifty-per-cent greater torque for one minute, and will have a full-load speed of 630 revolutions per minute. These motors will be of the squirrel-cage type, but otherwise will have the same classification as the motors in the tractors.

Marconi Company Begins Suit.

The Marconi Wireless Telegraph Company has entered suit in the United States Circuit Court at Trenton, N. J., against the National Electric Signaling Company, claiming that its patent rights have been infringed.

Electric Drive in Paper Mills.

The accompanying illustration (Fig. 1) shows the operation of two beaters driven by a 150-horsepower induction motor through chain belts at the Kimberly Mill of the Kimberly-Clark Company located on the Fox River. The capacity of this mill is eighty tons of book paper per twenty-four hours. It may be stated that the mill machinery is operated electrically while water power, and steam and oil engines are utilized for the generating of electric current.

There are two power stations which supply current to the mill, both being located on the Fox River, one in the mill itself and the other at Appleton, Wis., five miles up stream.

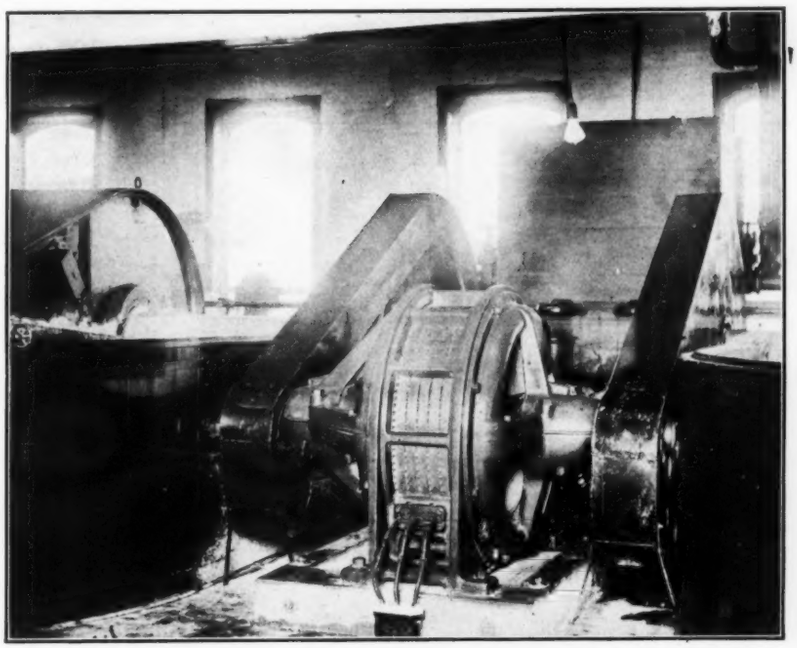


FIG. 1.—TWO BEATERS IN PAPER MILL.

It is of interest to note that the available head at Appleton is sixteen feet. Energy from a 750-kilowatt three-phase 6,000-volt General Electric generator is transmitted to a substation at the mill, where it is stepped down by means of three 300-kilowatt transformers to 470-volts pressure. There is a 700-foot crib dam across the river and a head of nine feet is available. The water-wheel equipment consists of nine vertical-shaft reaction turbines. Five of these are geared to a common horizontal shaft, to which a 300-kilowatt generator is coupled.

In the same way the remaining four turbines are connected to a second 350-kilowatt generator, but in addition to the water-wheel drive this generator is also arranged for oil-engine drive, the generator being located between the turbine-driven shaft and an oil engine and equipped with removable couplings on both ends of the shaft. It will be noted that the oil engine can be readily utilized to operate the generator during periods of low water. In addition to these there is one 350-kilowatt generator mounted between two oil engines and direct driven by them, and one 175-kilowatt generator, also oil-engine driven. The exciters are belt connected and arranged for parallel operation. There is also a large steam engine included in the equipment which is utilized to drive a 360-kilowatt generator and exciter. It will be seen from the above that by a subdivision of the generating equipment and the various prime movers available any possibility of interruption to the electric service is reduced to a minimum.

It is evident that the application of motors to paper-mill machinery in this plant exemplifies the adaptability of both the group and individual drive as well as of the different methods of connecting the motors to the machinery, there being examples of direct connection, belt and chain drive, and motors direct geared to the driving shaft.

There are eight agitators driven in a group by one sixty-horsepower motor and in the beater room there are three Jordans driven by three 150-horsepower motors.

It may be stated that these motors are

equipped with a special adjusting device which permits the motor to move on a sliding base with each change in the adjustment of the Jordan, and thereby operate at all times at maximum efficiency. The control panels for these motors are mounted on a small gallery so that the operator can manipulate them and have an unobstructed view of the motors, while at the same time they occupy no useful floor space.

It is of interest to compare these machines with three other Jordans in this room, which constitute an older equipment; they are driven from a countershaft, which is belted to a 300-horsepower motor mounted on the floor below, the control being installed on the floor beside the Jordans. There are also three other motor-driven Jordans, two of them being operated by a 250-horsepower motor while the third is provided with a 150-horsepower motor. These three machines are belt driven and are not ordinarily used in production, being held as an emergency equipment in the event of injury to the other Jordans.

In addition to the pair of beaters shown in Fig. 1 there are also four other beaters group-driven by a 250-horsepower motor. Many other motor-driven machines are used in the Kimberly Mill, these being in the washer room, finishing room and other departments.

The adaptability of electric drive in pulp and paper mills is also well illustrated by the equipment of the Berlin Mills Company at Berlin, N. H., where electric current is obtained from a hydroelectric power station, situated about three and one-half miles down stream from the mills. The turbines at this station operate under a thirty-foot head, each turbine being direct connected to a General Electric 750-kilowatt 12,000-volt three-phase forty-cycle alternating-current generator.

In this power plant there are also two sixty-five-kilowatt 125-volt exciters each direct connected to a horizontal water turbine operating at 350 revolutions per minute.

On the raised platform at one end of the generator room the power-station switchboard is located and current is transmitted to the mills by means of aluminum cable. From the switchboard the current is transmitted at the generator voltage and stepped down at the mill by means of six 750-kilowatt 10,-500/575-volt air-blast transformers. The transformers are protected by disconnecting switches, and by lightning arresters which are installed in the transformer room. The air blast is supplied by a ninety-inch Sturtevant blower driven by a seventeen-horsepower induction motor belt-connected. In addition to this, there are held in reserve, two forty-five-inch Buffalo blowers each direct connected to a four-horsepower induction motor.

Fig. 2 shows the mill distribution switchboard, located on the main floor directly above the transformers. This board consists of eight panels, one for the incoming line, five for power circuits and two for lighting circuits. There is a 250-horsepower motor utilized in the ground-wood department for the operation of stock and water pumps for the ground-wood screens. This motor is located in the basement and drives the pumps through countershafting.

It will be noted in Fig. 3 that the chipper-room machinery consisting of two eighty-two-inch chippers, one chipper screen and a re-chipper is driven from a main line shaft operated by a 200-horsepower motor which drives through a rope drive, as seen in the illustration.

In the wood room there are twenty-seven beaters operated by two 150-horsepower motors in two groups of thirteen and fourteen machines respectively. In the screen room there are two motors of 150-horsepower and 300-horsepower capacity and in the beater room a 450-horsepower motor supplies the power, while a large number of smaller electric motors are employed about the mill.

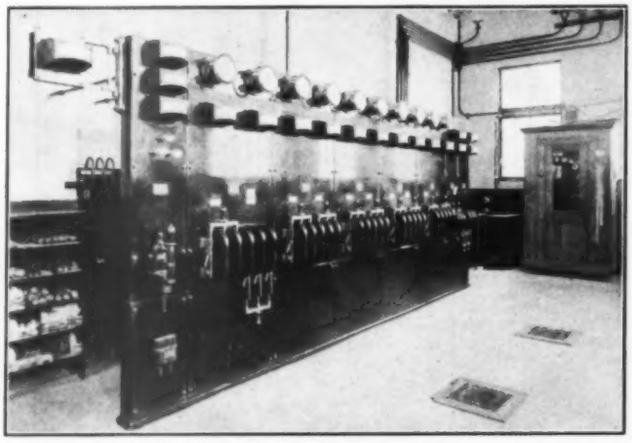


FIG. 2.—SWITCHBOARD IN BERLIN PAPER MILL.

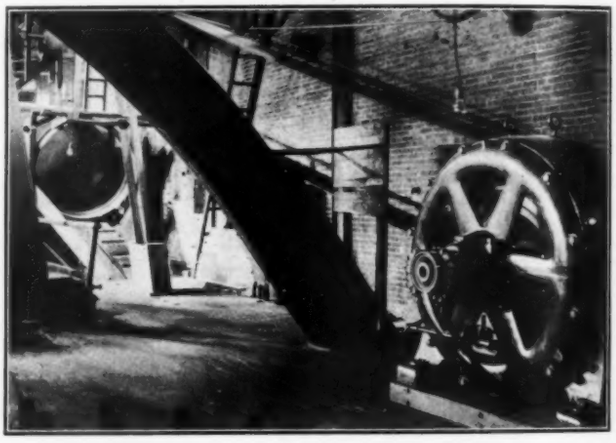


FIG. 3.—200-HORSEPOWER MOTOR DRIVING CHIPPERS.

Railless Traction in Vienna.

The municipality of Vienna has been obliged to face the problem of supplying railless communication in and around the city of Vienna by means of electric vehicles. As the municipality was unwilling to make experiments on its own account the Oesterreichische Daimler Motoren Aktien-Gesellschaft and the Akkumulatorenfabrik combined, are to construct the electrical lines. These lines will cover a distance of about two miles, and will be worked by the municipality when completed. If successful, an extension of the service is contemplated.

Threshing by Electricity.

Recent figures on the use of electric motors in threshing show that with a total power consumption of 220 kilowatt-hours 1,700 bushels of barley were threshed. The input of the motor during the operation averaged 20.5 kilowatts. As compared with the $2,000 investment involved in a steam traction engine the motor cost was about $250.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

CUMBERLAND TELEPHONE.

The report of the Cumberland Telephone & Telegraph Company for the month of September and nine months ended September 30, compares as follows:

	1911	1910
September gross	$626,425	$575,272
Expenses and depreciation	361,468	319,772
September net	264,957	255,500
Charges and tax	50,007	59,038
September surplus	214,950	206,462
Nine months gross	5,436,126	5,078,692
Expenses and depreciation	3,218,060	2,879,889
Nine months net	2,218,066	2,198,804
Charges and tax	458,362	434,974
Nine months surplus	1,759,704	1,763,829

PACIFIC GAS & ELECTRIC.

The Pacific Gas & Electric Company's consolidated income account for the earnings and expenses, all companies, year ending July 31, 1911, follows (inter-company revenue eliminated):

Gross revenue	$14,192,390
Operating expenses, taxes and reserves for uncollectable accounts, etc.	8,170,214
Net revenue	6,022,176
Interest and sinking funds	3,844,412
Surplus	2,177,763

LEHIGH VALLEY TRANSIT COMPANY.

The report of the Lehigh Valley Transit Company for the month of September and twelve months ended September 30, compares as follows:

	1911	1910
September gross	$134,059	$123,971
September net	81,421	74,570
Surplus after charges	41,273	37,706
Twelve months gross	1,326,196	1,161,706
Twelve months net	736,908	605,922
Surplus after charges	287,736	168,806

MASSACHUSETTS ELECTRIC COMPANIES.

The Massachusetts Electric Companies reports for the quarter and twelve months ended September 30, 1911, compared as follows:

	1911	1910
Gross	$2,799,061	$2,741,764
Expenses	1,560,208	1,434,626
Net	1,238,853	1,307,138
Charges and tax	472,969	459,512
Net income	765,883	847,625
Oct. 1 to Sept. 30:		
Gross	$8,938,815	$8,560,949
Expenses	5,682,884	5,360,295
Net	3,255,931	3,200,654
Charges and tax	1,851,786	1,792,936
Net income	1,404,144	1,407,717

MONTREAL STREET RAILWAY COMPANY.

The Montreal Street Railway Company has issued its pamphlet report for the year ended September 30, 1911. The income account compares as follows:

	1911.	1910
Gross	$4,775,301	$4,352,551
Expenses	2,679,806	2,455,301
Net	2,095,495	1,897,250
Int. from M. P. & I.	114,808	85,878
Total income	2,210,303	1,983,128
Charges, taxes, etc.	583,904	507,978
Surplus	*1,626,398	1,475,150
Dividends	1,000,000	1,000,000
Balance	626,398	475,150
Insur. and contingent fund	275,000	275,000
Surplus	351,398	200,150

*Equal to 16.26 per cent on $10,000,000 capital stock before charging out insurance and contingent reserves. This compares with 14.75 per cent earned on same stock previous year.

AMERICAN LIGHT & TRACTION.

The American Light & Traction Company reports earnings for twelve months ending September 30, compared as follows:

	1911.	1910.
Gross earnings	$ 4,105,097	$3,692,475
Expenses	114,133	116,495
Net earnings	3,990,964	3,575,980
Previous surplus	6,444,253	5,622,682
Total surplus	10,435,218	9,198,662
Preferred dividends	854,172	854,172
Common dividend	1,074,337	926,707
Stock dividends on common	1,074,537	973,530
Total dividends	3,003,047	2,754,409
Profit and loss surplus	7,432,171	6,444,253

ONTARIO POWER COMPANY.

The Ontario Power Company of Niagara Falls and the Ontario Transmission Company, Ltd., report for the nine months ending September 30, 1911, as follows:

Gross earnings	$622,443
Operating expenses	110,191
Net earnings	512,251
Other income	64,755
Total income	577,006
Interest	504,293
Surplus	72,713

The Ontario Transmission Company, Ltd., reports for the nine months ended September 30, 1911:

Transmission line rental	$120,735
Interest on bank	66,409
Surplus	54,325

KEYSTONE TELEPHONE COMPANY.

The report of the Keystone Telephone Company of Philadelphia, for the month of September and three months ended September 30 compares as follows:

	1911.	1910.
September gross	$ 97,573	$ 94,341
Expenses and taxes	50,576	46,595
September net	46,997	47,746
Charges	24,940	24,762
September surplus	22,057	22,984
Three months' gross	290,606	282,809
Expenses and taxes	148,885	141,222
Three months' net	141,721	141,587
Charges	74,435	73,640
Three months' surplus	67,286	67,947

TWIN CITY LINES.

The report of the Twin City Lines, for the month of September and nine months ended September 30, 1911, compares as follows:

	1911.	1910.
September gross	$ 689,096	$ 694,853
Expenses	315,396	323,061
September net	373,700	371,792
Charges, taxes and preferred dividends	140,079	140,286
September surplus	233,620	231,505
Nine months' gross	5,852,439	5,620,369
Expenses	2,898,788	2,688,107
Nine months' net	2,953,651	2,932,262
Charges, taxes and preferred dividends	1,260,712	1,261,653
Nine months' surplus	1,692,939	1,670,609

NORTHERN OHIO TRACTION.

The report of the Northern Ohio Traction & Light Company for the month of September and nine months ended September 30, compares as follows:

	1911.	1910.
September gross	$ 246,015	$ 224,901
Expenses	128,812	117,857
September net	117,203	107,044
Charges	44,321	43,391
September surplus	72,882	63,653
Nine months' gross	2,019,746	1,837,406
Expenses	1,110,504	1,009,858
Nine months' net	909,242	827,548
Charges	399,069	390,161
Nine months' surplus	510,172	437,387

VIRGINIA RAILWAY & POWER.

The Virginia Railway & Power Company has issued its pamphlet report for the year ended June 30, 1911. The income account compares as follows:

	1911.	1910.
Gross earnings	$2,244,589	$2,058,606
Expenses and taxes	1,284,980	1,023,729
Net earnings	959,609	1,034,877
Other income	46,296	33,161
Total income	1,005,905	1,068,037
Charges, etc.	497,654	698,319
Surplus	508,250	369,718
Preferred dividends	228,652	66,693
Surplus	279,598	303,025
Previous surplus	297,369	.....
Total surplus	576,967	303,025
Adj. (credit)	2,481	*5,656
Profit and loss surplus	579,448	297,369

*Debit.

To Start Telegraph System.

At the annual meeting of the Louisville & Nashville Railroad Company, the stockholders voted to authorize an amendment to the by laws permitting the company to own and operate its own telegraph and telephone service, and to engage in commercial service in connection therewith.

In 1884 the Louisville & Nashville entered into an exclusive contract with the Western Union for the latter's operation along the line of the former. This contract was revocable after twenty-five years by either party on twelve months' written notice. Such notice was given by the Western Union, August 17, 1911.

Western Electric's September Sales.

The Western Electric Company is reported to have experienced a most satisfactory revival in orders billed out of its factories in September. After four months of comparative declines shipments came back showing by far the best increase for many a month and the largest this fiscal year. The gain was twelve per cent and September sales were the largest for that month in the company's history.

For the nine months to September 30, Western Electric gross was four per cent in excess of the same period last year and a total overturn for the full twelve months of $66,000,000 is promised.

The company will by the first of January be able to occupy some 200,000 square feet of new floor space at its Hawthorne, Chicago, plant. Among other additions this space includes a new general merchandise building.

Candlepower and Voltage.

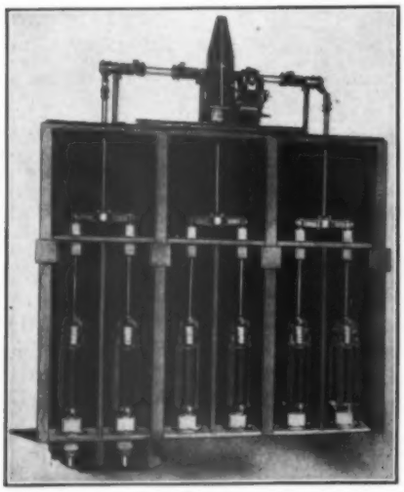
A five-per-cent increase of voltage changes the candlepower of a carbon lamp by thirty per cent; of a tungsten lamp by twenty per cent.

New Electrical and Mechanical Apparatus and Appliances

RECENT DEVELOPMENTS IN OIL-SWITCH DESIGN.

BY D. S. MORGAN.

The motor-operated type H oil switch has, for several years, been one of the most successful and the most widely used oil circuit-breaking devices for rupturing large capacities that has been placed in commercial service. Oil switches of this type are installed and operated in every country in which electric power is being developed, and the switch as manufactured today is practically of the same design as the original, slight changes only being necessary to meet special conditions due to the severe demands of electrical practice.

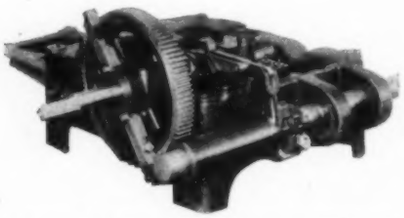


TRIPLE-POLE, 2,000-AMPERE OIL SWITCH.

This switch was developed at a time when the kilowatt capacity of generating units was comparatively small, the operating speeds low and the regulation poor. The introduction of the high-speed steam turbine for operating large generating units has brought about a demand for switching apparatus of high rupturing capacity; and, because experience has shown that this type of switch is capable of rupturing large amounts of power, two new switches of similar design, but with greater rupturing capacity, have been developed for use in central stations where several large steam-turbine generating units are installed. They will be known as the "H-6" and "H-7" and are identical except for a few details necessary to adapt them to different styles of cell construction.

Both switches are designed for mounting the different phases in separate cells but the "H-7" oil switch is so arranged that further separation is secured by the addition of barriers placed between the breaks of each phase.

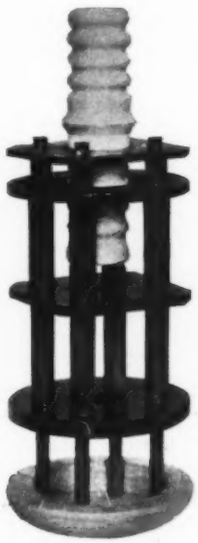
The secondary contacts of the improved switches are, with slight modification, similar to those used in the previous types, and consist of a movable cylindrical rod, which makes contact with the inner surface of four segments of a cylinder, secured in position by helical springs. This arrangement insures heavy and uniform contact pressure, and also automatically compensates for any wear of the surface of either the stationary contact segments or the cylindrical contact rods. When the arc is ruptured, whatever burning results takes place on the bell-mouth of the stationary contact and the rounded tip at the lower end of the movable contact rod, and in no case causes damage to the working contact surfaces. The contacts are self-alining and easily renewable.



LOCKING DEVICE FOR TYPE H SWITCH.

For current capacities above 300 amperes, however, additional contacts, known as primary contacts, are also provided. These are shown herewith, and serve to carry almost the entire current while the switch is closed. This is their only office; for in opening the switch, they break contact before the cylindrical rod which opens the circuit and ruptures the consequent arc in oil. The movable primary contacts consist of double sets of contact fingers made of drop-forged copper, fastened to a movable cross-head by flat springs fitted with copper laminations and reinforcing springs. The tension of these springs insures good contact but does not retard the opening of the switch. The stationary primary contacts are wedge-shaped copper blades fastened to the top of the oil vessel. This construction of contacts imparts a distinct rubbing movement in opening and closing, and insures perfect contact between the contact surfaces.

The diameter of the oil vessels has been increased from eight to ten inches, giving a larger volume in the oil vessel. The larger oil vessels have also been made stronger by increasing the thickness of the steel walls.



BAFFLE PLATE FOR TYPE H SWITCH.

Another improvement, to increase both the rupturing capacity and the reliability of the switch, consists of baffle plates of new design. By these the movement imparted to the oil by the expansion of the gases formed by the arc when the circuit is opened, is checked and diverted in such manner as to allow the gases to separate from the oil and escape, while the oil itself drops back. An illustration of the new baffle is shown herewith. The illustration indicates the movement of

the oil away from, and towards, the center of the oil vessel on breaking the circuit. The oil loses its velocity before it reaches the cover of the oil vessel, and therefore its tendency to be thrown out is reduced.

As in the other types, the new switch is opened and closed by compression springs. The operating motor does not actually throw the switch, but serves merely to compress the springs. The weight of the movable parts of the switch is counterbalanced so that when the switch operates, the force of the compression springs closes the contacts by throwing the lever to approximately 1.5 inches from the opposite position, after which the motor compresses the springs for the remainder of the distance. The switch closes and opens with equal ease. The operating springs are held in compression by the main operating toggle of the switch and by a dog bearing against a roller-stop, which, when released, allows the switch to operate. The main operating toggle is slightly over center when the switch is at rest, thus the pressure of the dog against the roller-stop is merely sufficient to overcome the tendency of the main toggle to buckle. The means of holding and releasing the dog always insures positive operation of the switch. When the switch is operated, it either closes or opens, as the case may be, in one single stroke.

The "H" type switches are built in current capacities up to 4,000 amperes for voltages up to 15,000. They are also made for voltages up to 70,000 and will operate satisfactorily on systems the combined load of which connected to the bus is not greater than 50,000 kilowatts. In many cases, however, they can be recommended for rupturing capacities in excess of this, depending upon the particular features of the installation. They are made in two forms, one in which the poles are made in parallel sets of two, as in previous designs, and the other in which the poles are arranged in tandem. The General Electric Company is the manufacturer.

Connector Puller for Disconnecting Cells of Vehicle Batteries.

The individual cells in the various types of "Exide" storage batteries are joined together by connectors integrally burned to the strap post. This burned connection is the most positive and satisfactory. When one or more cells have to be cut out, it has heretofore been customary to do this in one of two ways: either loosening the connector by putting a flame on the burn, over the post, or boring through the burn with a brace and bit.

The Electric Storage Battery Company has now perfected a connector puller, a device which mechanically uncouples the connectors by shearing, leaving both post and connector in perfect condition for reburning. In order to accomplish this, it is necessary that the plunger which does the shearing be very accurately alined and centered. This connector puller has been so designed that the centering is done in a very positive manner, and the connector must come off true.

CONNECTOR PULLER.

PULLER IN PLACE.

The connector puller fits the pillar strap of all types of "Exide" cells, including the "Ironclad-Exide," and is manufactured in two sizes. One size, No. 8879, fits all cells corresponding to the thirteen-plate "Exide" and smaller, while the other, No. 8880, fits those corresponding to the fifteen-plate "Exide" and larger. The two illustrations, showing the puller alone and in place ready to work, make clear the method of operation.

M., K. & T. Adopts Telephone Train Dispatching.

W. H. Hall, superintendent of telegraph of the Missouri, Kansas & Texas Railroad, has completed the construction of two telephone train-dispatching circuits which have been in operation since October 1. Mr. Hall reports the circuits working smoothly and the operating people who are handling the excessively heavy fall traffic wonderfully pleased with the relief afforded by the telephone.

On the Chattaw Division the McAlester dispatcher handles the double-track main line from McAlester ninety-five miles south to Denison, Texas, with a part of the Oklahoma City line from Atoka on the main line, west to Coalgate, Okla. Way stations located at frequent intervals along the line are connected with the telephone circuit and on the single-track sections the blind passing tracks are provided with booth telephones.

The way-station equipment consists of telephone arms of the accordion type, equipped with head band receivers and Gill selectors of the two-figure main-line bell type, on which the clearing-out impulses have been eliminated. All calls are completed within three and one-half seconds. At non-test offices the line wires terminate on knife switches, which when open disconnect all office equipment, including the lightning arresters, from the line. Knife-switch panels are provided at test offices to facilitate opening the line to locate faults or patching a section of emergency line into the circuit in case of trouble.

The roomy wooden booths at the blind sidings are fitted with small wall telephones mounted above wide writing shelves. Knife switches are provided to disconnect the telephone and lightning arresters from the line when not in use, and the booth doors are equipped with standard switchlocks.

The Waco Division circuit is an exceedingly busy one extending from Smithville, Texas, the dispatcher's office, 158 miles north to Gillsboro, and includes forty-seven miles of the important San Antonio line from the junction at Granger west to Austin. Thirty-four way-telephone stations and nearly as many booth telephones are installed on the circuit.

Wire-chiefs' test boards arranged with voltmeter and mil-ammeter tests are located at the terminals.

"Precision" Boring Tools for Wiremen.

The need for a new way of holding tools in a bit brace has been apparent to electricians, millwrights and others who have been annoyed by the looseness of fit of the common square-shank bit and the not infrequent pulling out of the extension. These defects have been entirely overcome by changing the shape of the bit shank and introducing an entirely new design of holding chuck.

The Russell Jennings Manufacturing Company is placing upon the market boring tools which have a patented turned shank about two inches long with a slot three-eighths inch deep in the end in place of the common square shank. A portion of this shank is tapered slightly down to the shoulder. When inserted in the chuck the shank is prevented from turning by the slot fitting over a key in the bottom of the patented chuck. It is kept in perfect alinement by the close-fitting split bushing in the chuck which

BOX OF BORING TOOLS.

fits over the bit shank, both bushing and shank having the same taper. Tightening the chuck, even with slight pressure, grips the taper shank so that the bit cannot be pulled out.

The advantages of the new "Precision" boring tools for electric wiremen claimed by the manufacturer are first, the tight grip on the shank whether the bit is held in the brace chuck or in the extension; second, the reduction of time required for placing or removing tools; and third, the perfect alinement. With little effort applied to the chuck, the turned shank of the bit is held so securely that the alinement is perfect from the head of the brace to the spur of the bit.

With this new chuck there is no tendency of the shank to work loose while the bit is in use. The chuck of the bit extension is of exactly the same design as the brace chuck and holds the bit in the same way. The bit extension also has the same taper and shoulder and slotted shank as the bit. The user of such a combination feels absolute secure that under no conditions can the bit extension be pulled away from the bit brace nor can the bit be pulled out of the extension.

RUSSELL JENNINGS PRECISION CHUCK.

In order that wiremen may take advantage of this new shank without entirely discarding their square-shank tools the Russell Jennings Manufacturing Company makes also a "Universal Precision" chuck which takes either the common square shank or the new "Precision" shank.

Calorized Electric Soldering Iron.

The use of the ordinary soldering iron has two serious drawbacks—the impossibility of keeping it hot continuously, and the rapid wasting away of the copper. The development of the electric soldering iron obviated the former, furnishing the mechanic with an iron which not only stayed uniformly hot all the time, but one in which the heat intensity could be easily regulated by the mere turning on or off of the current. The second fault, that is, the rapid wasting away of the copper, still remained, to a large extent, necessitating frequent renewals, and consequently making no reduction in the cost of maintenance.

Therefore it is of much interest to metal workers to know that many experiments made in the research laboratories of the General Electric Company

RUSSELL JENNINGS UNIVERSAL PRECISION CHUCK.

to mitigate this fault has resulted in the discovery of a process of treating the copper which renders the latter non-oxidizable under high heats and non-corrodable by the acids used in soldering. Furthermore it reduces to a minimum the dissolving action of the molten tin, with which the working tip must always be kept coated.

The General Electric Company states that this "calorizing" process or method of treatment does not merely coat the surface of the copper with a thin layer of non-oxidizable or non-corrodable substance, liable to scale off under the effects of heat and acids, but actually changes the characteristics of the copper to an appreciable depth. Thus the durability or practical working life of the copper is increased to such an extent as to provide a soldering iron of maximum economy and effectiveness.

Novel Electric Sign in Baltimore.

The Emerson Building, one of the tallest skyscrapers in Baltimore, Md.,

ELECTRIC SIGN ON EMERSON BUILDING.

is surmounted by a unique electric sign advertising one of the products of the Emerson Drug Company. The sign is an exact reproduction of a bottle of bromo-seltzer, and it is illuminated with 554 sixteen-candlepower incandescent lamps. These are arranged in letters ten feet high and six feet wide. The entire sign is seventy feet in height and over twenty feet in diameter. It contains 60,000 pounds of material. The entire sign rotates twice per minute, being driven by an electric motor of three horsepower.

The sign was constructed by Vaile and Young, the engineers being Williams and Shock. The material with which the bottle is covered is galvanized toncan metal, this having been chosen in preference to copper. The material was supplied by Kahl-Holt Company of Baltimore.

Electric Railway Progress.

During the last year or so there have been very important developments in electric railway appliances. With street railways, cars and loads have become heavier and schedule speeds have increased. In spite of these conditions, progressive managers have been able to reduce maintenance costs adopting the modern equipment designed to operate with minimum expense for repairs. Existing interurban lines have extended and many new properties have come into existence. Steam railroad men have become less timid in regard to electrification and several very important steam road installations have been made.

Among the noteworthy installations of complete equipment and of motors and control that have been made or contracted for by the Westinghouse company during the past year may be mentioned the following:

Boston & Maine Railroad, Hoosac tunnel electrification, 11,000 volts, single phase.

New York, Westchester & Boston Railroad, 11,000 volts, single phase.

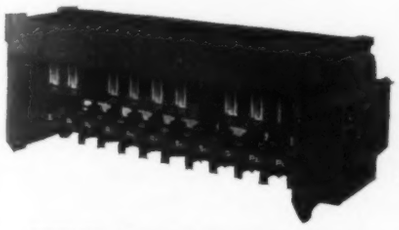
Rock Island & Southern Railroad, 11,000 volts, single phase.

Piedmont Traction Company, 1,500 volts, direct-current.

Oakland & Antioch Traction Company, 600-1,200 volts, direct-current.

The Cambridge Subway, 600 volts, direct-current.

The Boston Elevated Railway Company, 600 volts, direct-current.



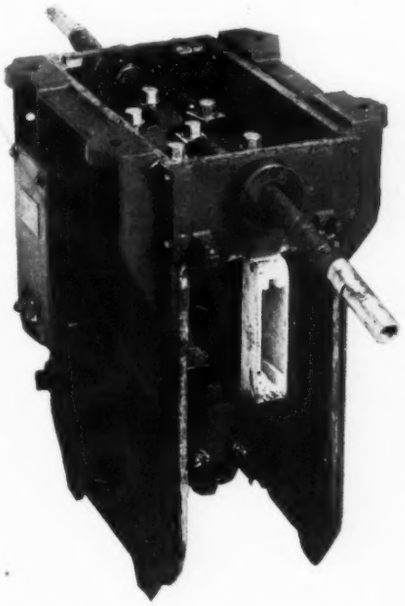
SWITCH GROUP OF HL CONTROL.

The Long Island Railroad, 600 volts, direct-current.

Interborough Rapid Transit Company, 600 volts, direct-current. One thousand (1,000) pneumatically operated line switches were furnished for New York subway cars.

Pennsylvania Railroad, 600 volts, direct-current.

The single-phase system has been adopted for three very important projects, namely, the Hoosac tunnel electrification, the Rock Island & Southern, and the New York, Westchester & Boston installations. The fact that this system was selected after the most exhaustive studies effectively substantiates the claims of its advocates as to the advantages of single-phase operation for certain conditions. Seventeen additional single-phase locomotives have been purchased by the New York, New Haven & Hartford Railroad for operation on its main line. The single-phase operation



ELECTRO-PNEUMATIC LINE SWITCH.

of the recently electrified Hoosac tunnel installation is eminently satisfactory.

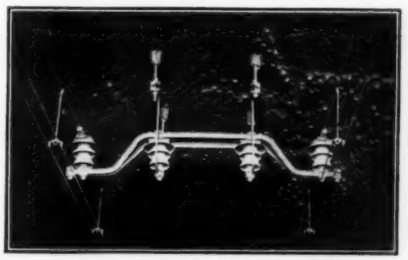
The Piedmont Traction Company has contracted for complete equipment for its 1,500-volt direct-current system. About 280 miles of track are to be electrified for passenger and freight service. This is the longest direct-current road in the country and the voltage is the highest ever used for a direct-current railway in the United States.

The demand for interpole railway motors has increased considerably during the past year. Many companies that did not at first sufficiently appreciate the advantages of interpole construction and were slow to change over from non-interpole motors are standardizing motors of one of the interpole types. Interpole motors are being specified for nearly all new equipment and can now be furnished for practically all commercial railway applications. A new interpole motor is the Westinghouse No. 323, a thirty-two horsepower motor designed for use on small cars. Interpole motors have not heretofore been made of such small capacity and many companies operating small cars that have not in the past been able to avail themselves of the advantages of interpole construction can now do so.

The advantage of forced ventilation for railway motors is now being appreciated by operators. Forced motor ventilation has been used for the Westinghouse motors installed on the Long Island Railway and the Pennsylvania Railroad motor cars and has proven particularly successful. Forced ventilation has frequently been used on Westinghouse locomotives. The New York, New Haven & Hartford, the St. Clair Tunnel, the Spokane & Inland, and others have been so equipped.

There has been a feeling among operators that unit-switch control can be used with economy only for the control of long trains or for heavy high-speed cars. That this impression is erroneous is indicated by the order recently placed by the Boston Elevated Railroad Company for fifty equipments of unit-switch control for its surface cars. This makes a total of 100 surface-car unit-switch equipments operated by this company. Unit-switch control is becoming popular not alone because it tends to reduce car maintenance but because it removes all heavy current-carrying parts from car-platforms and eliminates all annoying troubles and claims resulting from controller burn-outs.

In the following paragraphs is given a brief summary of the equipment sup-



11,000-VOLT LINES IN HOOSAC TUNNEL.

plied to the roads, previously mentioned, by the Westinghouse Company:

For the Hoosac Tunnel electrification the Westinghouse Company furnished the entire equipment, including all control apparatus, station equipment and the 11,000-volt overhead line material. Six locomotives have been in service since the latter part of May, each having a rating of approximately 1,500 horsepower. Half of these are geared for a speed of thirty miles per hour for hauling heavy freight trains. The others are geared for fifty miles per hour,

and are used for handling the passenger service.

The Rock Island & Southern Railway commenced operating its 11,000-volt single-phase road early in the year, and the equipment has given complete satisfaction. The road is 49.7 miles long, and the passenger cars are each equipped with four 132-C motors, rated at 100 horsepower, and with unit-switch control. One express is equipped with four No. 156 motors and unit-switch control and one freight car is equipped with four No. 156 motors and unit-switch control.

The equipment furnished for the New York, Westchester & Boston Railway includes thirty motor cars, each propelled by two Westinghouse No. 409-B motors with multiple-unit control, and one thirty-ton switching locomotive equipped with quadruple No. 410 motors.

The New York, New Haven & Hartford Railroad has been extending its electrified zone, and has purchased seventeen additional Westinghouse single-phase locomotives with a view to establishing the best class of service. These locomotives are equipped with four driving axles, but have eight motors, two motors geared to a quill surrounding each axle. Both motor pinions drive the same gear which permits the use of only one gear on the quill.

Each of the locomotives supplied for the Pennsylvania Railroad electrification weighs, complete, 157 tons and exerts a maximum draw-bar pull of 79,200 pounds. The normal speed with full train is sixty-six miles per hour. The motors are connected, first, with full-field series; second, normal-field series; third, full-field parallel; fourth, normal-field parallel. This method gives four highly efficient operating speeds.

The Pacific Electric Railway Company operates a network of 600-volt, ballasted and signalled, roads radiating from the city of Los Angeles, Cal. The cars must operate at low speeds in the cities and at high speeds in the country. Westinghouse field control has been applied. Westinghouse field control is destined to be the solution for interurban problems, in that it permits, with moderate gear ratios, high interurban speeds and slow city speeds.

The Westinghouse Electric & Manufacturing Company has secured the contract for the entire equipment of the Piedmont Traction Company and the Greenville, Spartanburg & Anderson Railway Company with 1,500-volt direct-current apparatus. Electro-pneumatic control, which is peculiarly adapted for use on high-tension direct-current voltages will be used, and while the motors will be of Westinghouse standard interpole construction, the matter of commutation has been given special attention.

The Boston Elevated Railway Company first ordered fifty No. 306 motors and HL control, which gave such extraordinary satisfaction that fifty additional duplicate equipments were ordered. The cars on which these equipments are to be used, although they operate on the surface, connect with the Boston Elevated lines.

The Cambridge Subway in Boston is a new and notable rapid-transit project. This subway, which is almost completed, will reduce the schedule between Harvard Square, Cambridge and Park Street, to eight minutes. There are but two stations between terminals, one is in Central and the other in Kendall Square. The Subway will cost $8,000,000. The electrical energy will be supplied to the cars at 600-volts direct current. All of the car equipment consists of outfits of No. 300 interpole motors and AL unit-switch control.

A feature of the electrical equipment of the Long Island Railroad cars is the application of forced ventilation for the motors used on the high-speed trains. It was desirable to obtain the highest possible outputs from the motors and maximum output was secured through the use of cooling air which is directed by a motor-driven fan into the motor frames. Forced ventilation is often advantageous and has frequently been used on electric locomotives by the Westinghouse Company with uniformly successful results. The Long Island Railroad car equipments consist of two Westinghouse No. 308, 225-horsepower motors and Westinghouse automatic unit-switch control.

The Oakland & Antioch Railroad, of California, has recently purchased Westinghouse quadruple seventy-five-horsepower, 600-1,200-volt motors, Westinghouse 115-horsepower, 600-1,200-volt quadruple motors and one forty-seven-ton locomotive provided with quadruple 120-horsepower motors. All are to be equipped with double-end HL control. The seventy-five-horsepower motors and the 115-horsepower motors are to be mounted on cars of the same weight.

A NEW DEPARTURE IN THE DECORATIVE LIGHTING OF AMUSEMENT PARKS.

BY G. A. BARKER.

Progress, in all lines of human endeavor, is achieved by those who have the faith and the courage to handle modern implements while they are still more or less unfamiliar and untried. To eliminate 7,000 carbon-filament sign lamps of a standard tested and tried type and to replace them by the recently developed 2.5-watt metal-filament lamps, thereby creating a precedent in amusement-park lighting on a large scale, requires the strongest kind of confidence in the quality of the newer lamps. This step was taken last spring by the management of "Paragon Park," the well known amusement resort at Nantasket Beach, Mass., and the progressiveness exhibited is none the less noteworthy because experience—now that the summer park season is over—has shown it to have been justified. An equal degree of confidence and initiative was manifested by the Boston electrical concern (Pettingell-Andrews Company) which recommended and engineered this change in decorative lighting equipment, and also by the "Peerless" lamp manufacturers, who co-operated with the Boston company on all details involving qiuestions of lamp performance.

A reduction in current consumption from 10 watts to 2.5 watts per lamp, with no decrease in initial candlepower and with better maintenance thereof throughout the period that the average lamp is in service, has been effected at Paragon Park, and in addition the greater brilliancy and whiter color of the high-efficiency lamps have actually made the Park seem more strongly illuminated than it was in previous years, and have sensibly increased its general attractiveness. The effect has also been enhanced by the addition of new elecric signs and by exensions of the outline lighting system, which, however, absorb but a fraction of the released load.

The lamps used in the ornamentation of this amusement resort are apportioned approximately as follows: To the park's most prominent landmark—the tower which rises at its center—are allotted some 4,000 lamps; 2,000 more are used in the outlining and decorating of the palm garden and pavilion. 400 in the large "thirst" sign above the palm

garden, 400 on the band stand and 200 in various other parts of the park. The several structures just mentioned can all be discerned in the illustration.

Local low-potential transformers having a 10 to 1 ratio are used to step down the voltage of the central-station supply to that required for the sign lamps, which are designed to consume their rated input, 2.5 watts, at a pressure of eleven volts. Current is secured on contract from the Weymouth Electric Light Company. The peak load contributed by the park lighting during the busy season is normally about 275 kilowatts, and this value is maintained for about four hours daily, while for six hours out of the twenty-four the park

ILLUMINATION OF PARAGON PARK.

runs at about half of its peak consumption. Thus the sign lighting constitutes but a small portion of the total load,—in fact the ceiling of the palm garden alone, studded as it is with nearly 1,000 lamps of the twenty-five-watt, 110-volt type, consumes more current than all of the 7,000 sign lamps put together.

The amusement park at Nantasket Beach, located about eleven miles in a south-easterly direction from Boston, Mass., across the harbor, has been operated for seven years under the name of "Paragon Park" and has become the most popular place of its kind east of Coney Island—the total attendance during the season aggregating 800,000 or more. Notwithstanding its present popularity and prosperity, it is said to have been, for several years after its incipiency, a losing proposition financially. As with every closely-run enterprise, it is the many little items of needless expense, and the many minor economies, that in the long run swing the needle of the business indicator towards loss or towards profit. The remodeling of the sign lighting at Paragon Park is a specific instance of the sort of economies in question.

The evolution of the sign lamp itself has been rapid and has been marked by great improvements in efficiency. For years the two most common types of lamp for sign lighting were the two and four-candlepower carbon-filament lamps, consuming about 10 watts and 19.6 watts, at efficiencies of 5 and 4.9 watts per candle respectively. The first sign lamp with a tungsten filament consumed 5 watts at 1.33 watts per candle (old candle) or 1.31 watts per candle (International candle), while the 2.5-watt Mazda lamp (rated at the same efficiency) is a more recent development.

Monel Metal Sheets.

It is stated that the new "natural alloy" monel metal, which is claimed to be as strong as steel and less corrodible than bronze, is now furnished in all the common sheet-steel sizes, gauges and finishes. These sheets are soft, strong and tough, with a tensile strength of two to three times that of copper. They may be spun or drawn and polish readily, giving a finish similar to pure nickel and approaching that of sterling silver.

Sheets of this new metal are very well adapted for roofing purposes, as they solder and braze readily, giving joints which are stronger than similar joints on copper and they may be readily formed into suitable shapes or bent into locks. The expansion and contraction of Monel metal is claimed to be only eighty-five per cent as great as that of copper.

For engineering purposes it is equally valuable, possessing with its other qualities resistance to abrasion and a high resistance to distortion under working stresses, due to its modulus of elasticity.

A New Voltage Regulator.

A patent granted to Simon B. Storer covers a device in which the voltage

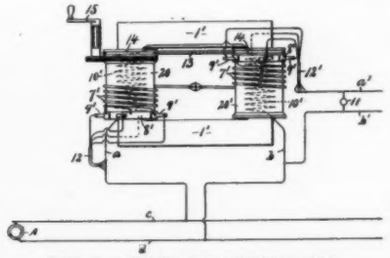


FIG. 1.—VOLTAGE REGULATOR.

of a circuit is varied by turning reels upon which the secondary coils of the transformer are wound. The reels and secondary coils surround the primaries and by rotation in one way or the other the number of effective turns is

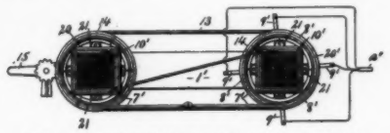


FIG. 2.—SECTIONAL VIEW OF COILS.

gradually increased or diminished as desired. The chief advantages as claimed by the inventor are that the voltage changes are effected smoothly making much closer regulation possible than could be obtained with a step-by-step device, where each step involved a variation of several volts.

In Fig. I are shown the two primary coils 10 and 10′ and the reels upon which are wound the secondary coils 7 and 7′. A sectional view of the coils and transformer is shown in Fig. 2. It will be noted in the first figure that the load 11 is connected on the side b^1 directly on the line b the generator. The other side a^1 connected to the generator through secondary coils.

When connected in this way the sec-

ondary winding will have generated in it voltages in opposition, so that when all the coils are on one reel the line voltage will be raised and when all are on the other it will be lowered by the same amount. In all intermediate positions it will be added to or subtracted from in proportion to the number of turns wound on either spool. The secondary winding must of course be of flexible cable.

It is obvious that if for the purpose of introducing current to or taking current from the secondary winding, each end of the secondary coil were connected to a metal collector-ring mounted on the core, or rather on one end of each reel and surrounding the core, the collector-rings would act as a short-circuited secondary winding and render the device inoperative. For this reason each current collector is made up of a like number of segments, which are shown in Fig. 1 at 8^1, one segment of each collector being connected to a similar segment of the other collector by a separate, comparatively fine wire or cable. Each cable is insulated, and the length of each cable is such that it prevents short-circuit current flowing therein from exceeding a relatively negligible value.

Louisville & Nashville Installs Additional Telephones for Train Dispatching.

The Louisville & Nashville Railroad recently placed an additional order with the Western Electric Company for forty-two of its No. 50 selectors to dispatch its trains over a new line to run from Lexington, Ky., to Quicksand, Ky. This road is now operating over 2,200 miles of circuits by the telephone, and this newer method of dispatching its trains is proving such a success that it bids fair to supplant the telegraph on the remaining mileage of its line

The new line now being built will cover a total distance of ninety-six miles, and the dispatcher for it will be located at Lexington. A message circuit will parallel the train circuit on this line and will be equipped with the same number of stations.

Rockford Electric Show Exhibits.

The accompanying illustrations show two interesting exhibits maintained by the Wagner Electric Manufacturing Company and the H. W. Johns-Manville Company at the recent electric show held in Rockford, Ill., in conjunction with the convention of the Illinois State Electric Association.

WAGNER EXHIBIT.

H. W. JOHNS-MANVILLE EXHIBIT.

In the foreground of the view of the Johns-Manville exhibit is shown a show case, loaned by a local department store illuminated by the J-M Linolite system of illumination. The case contained goods of various colors and strikingly demonstrated that this system of lighting brings out true daylight colors. The company also exhibited Noark fuse, service and subway boxes; Noark inclosed fuses; J-M molded fiber conduit in various shapes; J-M friction and rubber tape; Electrotherm heating pads; Solderall and miscellaneous J-M specialties. The company was represented by H. M. Frantz, George M. Clute, and C. L. Johnson. A complete list of exhibits was given in our last issue.

Compound De Laval Turbine and Reduction Gear.

De Laval was the first to use spur gearing for lowering the speed of revolution of a turbine spindle to a figure better suited to the requirements of the machine to be driven. The original De Laval turbine, it will be remembered, comprised a single stage only, and hence the speed of revolution of the wheel was very high, ranging from 30,000 per minute in small sizes to some 10,000 in larger. Experience showed, however, that this system of operation was not very suitable for really large outputs, and in consequence the De Laval Steam Turbine Company, of Stockholm, is now constructing compartment-compounded turbines of considerable capacity; but in the case of machines driving direct-current generators it still retains the reduction gear.

One of these new types of 750-kilowatt capacity, is designed to run at 3,000 revolutions per minute, and the generator at 750, the required reduction in speed being effected by a 4-to-1 double helical spur gear. In essentials the gear is similar to that already used so successfully in the single-wheel type of De Laval turbine. A relatively lesser width of tooth can therefore be used. The pinion shaft is of considerable stiffness, and is supported on three bearings. The noise produced is stated to be very small, and at the official tests was not greater than that due to the generator. In a recent test with steam supplied at a pressure of 150 pounds and 160 degrees Fahrenheit superheat, the consumption was 16.8 pounds per kilowatt-hour.

Current Electrical News

CANADA.

(Special Correspondence.)

OTTAWA, ONT., November 1.—Since hydroelectric power was turned on in the city of Woodstock, Ont., the light commissioners have been able to make two cuts in the price of light there and another cut is now in sight.

It is understood that a deal is pending whereby the Grand Valley and the Brantford Street Railway companies are to be merged into a big scheme, to include a system of electric lines from Toronto to Detroit. Negotiations are said to be now progressing in New York, and an announcement will shortly be made.

At a meeting of the directorate of the London Street Railway Company, held in the city of London, Ont., at which H. A. Everett, president, and E. W. Moore, director, both of Cleveland, O., were present, it was decided to increase the capital stock by $250,000. The money, it is understood, will be put into extensions which will shortly be demanded by the city, under a clause in the company's charter. J. W. Williams, of Detroit, Mich., was appointed secretary-treasurer.

Hon. Adam Beck, chairman of the Ontario Hydro-Electric Commission, has submitted new estimates for the supply of power to Kingston, Brockville, Morrisburg, Cardinal and Prescott. The figures are for 10,000 down to 3,000 horsepower. For 3,000 horsepower Kingston will pay $30.25 and Morrisburg $13.07; and for 10,000 horsepower Kingston is quoted at $17.80 and Morrisburg at $11.46. The power will evidently come from Waddington, N. Y., in view of the low prices quoted for Morrisburg.

The Department of Public Works, at Ottawa, is preparing copies of all plans, projects and documents affecting power schemes on the St. Lawrence River for the guidance of the work of the Commission which will report to the Dominion Government as to the effect upon navigation arising out of the various power propositions. The idea is to harmonize the different power projects, and, while permitting power development in the St. Lawrence, to suggest such remedial works in connection therewith as will insure the navigation of the river being absolutely safeguarded.

The machinery, recently purchased in Europe by Hon. Adam Beck, for the purpose of demonstrating the use of electricity on the farm, and in the home, is now in Toronto, and will be used throughout the province of Ontario by a staff of demonstrators sent out to show the farmers, and their wives, that they can plow, thresh, cut hay, fill silos and do all kinds of farm and house work by machinery, driven by electric power. Electric milking machines also will be demonstrated. Some of the machinery will be installed at the Ontario agricultural farm at Guelph, and there will be an electric exhibit at the National Exhibition at Toronto next year.

Two hydroelectric power schemes are attracting attention in the province of New Brunswick. One company proposes to develop power at Lepreaux and transmit the same to the city of St. John for heat, light and power purposes. This company was unable last year to come to terms with the City Council relative to the erection of its poles in the city streets, but the effort will be renewed. The other power scheme is that of a company called the Eel River Light, Heat & Power Company, which proposes to develop power at a point some forty miles above the city of Fredericton.

Sherbrooke is the third largest city in the province of Quebec and is the commercial center of the Eastern Townships. It has long been felt that the one thing needed to make it a most important manufacturing center was a plentiful supply of cheap electric power. It was with this end in view that the Sherbrooke Railway & Power Company was organized. Development was commenced in July, 1910, and now comprises a splendid street railway system and power and lighting service. The charter of the company gives it the right to transmit and sell power throughout the St. Francis district. Transmission lines are being run from the power house to cover the district within a radius of thirty-five miles. Already several large contracts have been made for power.

An important announcement has just been made by Sir James Whitney, premier of Ontario, that the time has arrived for the discontinuance of the Hydro-Electric Power Commission and the creation of a new department of government, with a cabinet minister at the head, to take over the work carried on by the Commission. The new portfolio will be that of Minister of Power. Sir James said: "The great scheme for the utilization of electric power has been accomplished and is now in operation and practically within reach of the farmers and other residents in the rural districts, and I am glad to say that the cost of construction has been $85,000 less than the estimated cost. The Government contemplates furnishing electric power at cost to all sections of the province."

MEXICO.

(Special Correspondence.)

MEXICO CITY, MEX., November 1.—The Mexico Light & Power Company, which recently finished the construction of another of its great dams to conserve the water supply for its hydroelectric plant at Necaxa, will soon install additional equipment that will add 30,000 horsepower to the present capacity of the plant. The plant is now capable of producing 100,000 horsepower, of which 70,000 horsepower is being utilized. The demand for this electrical energy is increasing with a rapidity that is remarkable and orders are already practically booked that insure the use of the full 130,000 horsepower the plant will soon be capable of producing. It is announced in this connection that the Mexico Tramways Company, a subsidiary of the Mexico Light & Power Company, which owns the electric street railway system in the Federal District and this city, will soon begin the construction of an electric interurban line to run from here to Puebla, 129 miles; also a line to run from this city to Pachuca, 94 miles. The surveys for the Mexico City-Puebla line have been made and it is said that the route will pass through the most beautiful scenes of any electric line in the world, as it will run between the towering heights of Popocatepetl and Ixtaccihuatl. It is expected that this line will be a favored route for American and other tourists. The chief importance of the proposed Puebla line is that it will give this city a direct connection with one of the most important mining and industrial districts in the country. The operation of these two lines will require a large amount of additional power, which will be furnished by the transmission system of the Mexican Light & Power Company. This transmission system already extends from Necaxa to Mexico City, El Oro, Puebla and Pachuca.

The English company which has a concession to build a power plant on the Verde River at El Salto, State of San Luis Potosi, has closed a contract with the American owners of the adjacent land, which enables the company to proceed with work. It is proposed to develop some 40,000 horsepower. The fall, which is located near the boundary line of Tamaulipas and San Luis Potosi, has a height of about 260 feet, which, with the rapids above and below, is increased to nearly 400 feet. The river above the fall varies greatly in depth with the season, the stage fluctuating from three feet in dry times to twenty-five feet in flood. The fall is located near excellent agricultural districts, but distant from cities. It is proposed to transmit the power into San Luis Potosi, Matehuala, Tampico and other centers, and it is understood that the controlling company has also secured other water rights and will include Monterey in its power system. The property upon which the fall is located is an American-owned plantation, consisting of more than 1,000,000 acres.

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

A pamphlet issued by the Public Service Commission, First District, takes up the work of the body, its method of handling complaints and the expenses and other matters connected with the regulation of public utilities. Since the organization of the Commission more than 5,000 complaints have been received and investigated by the Commission; traffic in the subway has grown from an average of 456,000 passengers per day to an average of 758,000 passengers per day; revenue car mileage has increased from 37,184,940 to 57,110,868; side doors have been placed in all cars used in the express service of the subway, and have been ordered placed in all local cars; subway express trains have been increased from eight cars to ten cars each, and local trains from five cars to six cars each; rush-hour service in the subway has been increased from 18,600 seats per hour to 26,400 seats per hour. In addition the New York Edison and allied companies have reduced their rates, effecting a saving to their consumers which is estimated at $1,250,000 per annum; electric contracts have been simplified and their terms ordered published; uniform systems of accounts and uniform forms for annual and other reports have been established, not only for gas and electric companies, but also for all transportation corporations under the jurisdiction of the Commission.

In addition to the very complete data contained in the publication there are numerous illustrations and an inserted map showing the subway systems in New York City.

The Public Service Commission, Second District, has received and served upon the Buffalo General Electric Company the complaint of Frank C. Perkins, Erie County Bank Building, Buffalo, N. Y., objecting to the signing of a contract for service which contains a provision that in case the supply of current should fail, whether from natural causes or accident in any way, the company shall not be liable for damage to person or property resulting from

the use of the current. Complainant also objects to the provision which prevents the use of any electrical conductors for light, heat and power purposes other than those connected with the company's mains. Under this requirement, complainant states he will be unable to use a small gas engine and generator and conductors from same to the lighting circuit, for auxiliary service.

The Public Service Commission, Second District, has received the petition of the Keeseville Electric Company for permission to execute a first consolidated mortgage for $200,000 on all its franchises and properties and to issue a like amount of bonds for the purpose of paying for the water power of the Mooney horse-nail mill property at Ausable Forks, N. Y. The company now furnished electric light in the village of Keesville and towns of Ausable, Chesterfield and Peru. It proposes to build a new power house to install necessary machinery for generating a total of 500 horsepower in order that it may extend its operations to other parts of such towns and to the hamlet of Ausable Forks and the towns of Jay and Black Brook. Part of the proceeds of the bonds now asked for are to take up outstanding obligations of the petitioning company.

IMPORTANT DEVELOPMENTS.

(Special Correspondence.)

WORK BEGINS AT REDDING, CAL.—Work has been begun at the Big Bend of the Pitt River by the Northern California Power Company, on what is said to be the largest plant ever attempted in the state of California. About 120,000 horsepower will be developed from 250,000 inches of water turned from Pitt River, near the town of Wengler. It is estimated that the total cost will be $4,000,000. The work will not be completed for two years.

FLORIDA PLANT NEAR COMPLETION.—The new power plant of the Jacksonville Traction Company, which is said to be one of the finest installations of its kind in the South, is now about eighty per cent completed, and power may be supplied by Christmas. The cost of the new station, which is to be used exclusively for supplying power to operate the street cars in Jacksonville, will be between $450,000 and $500,000. The equipment of the plant includes two 1,200-kilowatt engine-driven generators and three 600-horsepower boilers. The company now operates about fifty cars, but the capacity of the new plant will be easily 200 cars.

WILL LIGHT NORTHERN SPAIN.—The Barcelona Company has been organized under the laws of Canada, with a capital of $25,000,000, and with the head office at Toronto. The company proposes to develop water power aggregating more than 250,000-horsepower and will also construct hydroelectric power plants to supply light and power to the city of Barcelona and the entire northeast section of Spain. The company has also acquired one of the tramways in Barcelona and concessions for suburban railways which will be built at once. The syndicate which will finance these new enterprises is headed by Dr. F. S. Pearson. Associated with him is the same group which controls the Rio de Janeiro Tramway, Light & Power Company, the Sao Paulo Tramya, Light & Power Company and the Mexico Tramways Company.

LIGHTING AND POWER.

(Special Correspondence.)

DEEP RIVER, IOWA.—Bonds for $7,000 have been authorized for an electric light plant. C.

MAYNARD, MINN.—This city is about to vote $5,000 in bonds for an electric light plant.

FLANDREAU, S. D.—This city is soon to vote on the installation of an electric light plant.

MANITOWOC, WIS.—This city has voted $40,000 for improvements to the light and water plant.

GALVA, IOWA.—This city will vote November 21 on the issuance of $8,500 in electric light bonds.

SUTTER CITY, CAL.—The Pacific Gas & Electric Company has installed an electric lighting system here.

TERRY, MONT.—It has been voted to grant a franchise to Mr. Phillips to install an electric light plant. C.

MANITOWOC, WIS.—The Council has voted $40,000 bonds for improvements to the light and water plant. C.

GLIDDEN, IOWA.—This city is soon to vote on the issuance of $10,000 in bonds for an electric light plant.

MARYVILLE, MO.—The Maryville Electric Light & Power Company is preparing to double its plant capacity.

WAHPETON, N. D.—The Northern Electric Company will erect a modern office and store building, to cost $10,000. C.

PONCA CITY, OKLA.—This city is about to vote on the issuance of $30,000 in bonds for an electric light plant.

RIVERSIDE, WASH.—W. F. Calvert plans for the erection of an electric lighting plant to serve this community. A.

CEDAR RAPIDS, IOWA.—A campaign has been started for permanent boulevard lights on the business streets. C.

WATERVILLE, KAN.—This city has sold bonds and will spend $50,000 on electric light plant, etc., which are to be built.

FERGUS FALLS, MINN.—The Otter Tail Power Company is planning the expenditure of $250,000 to increase its capacity. C.

MOUNTAIN HOME, IDA.—The Great Shoshone & Twin Falls Power Company has been granted a contract to furnish electric power to the city at three to four cents per kilowatt-hour. A.

SAN DIEGO, CAL.—City Heights and Normal Heights, suburbs of San Diego, have voted to install street lighting systems.

CASTLE ROCK, WASH.—The Tacoma Investment Company has been granted a franchise for an electric power system in this city.

GUERO, TEX.—The Electric Light & Power Company's plant here is to be enlarged. The proposed improvement will cost about $25,000. D.

COLTON, CAL.—The Southern California Edison Company has been awarded a contract by the City Council for street lighting at Colton. A.

ABERDEEN, WASH.—The Mutual Heat & Light Company, of Aberdeen, has been incorporated for $50,000 by W. Mack and M. Snyned.

BOYDEN, IOWA.—The Council has granted a franchise for the installation of an electric light plant to T. H. and J. J. Veanschoten. C.

DULUTH, MINN.—The North Shore Power Company has been incorporated with a capital of $50,000 by F. Chase, Mr. Gregor, Lincoln Graham and G. B. Christopherson.

BEAUMONT, CAL.—C. H. L. Ghriest, owner of the Newport Beach Electric Light & Power plant, is to establish a plant in Beaumont.

OAKLAND, CAL.—Residents of Castro Valley have petitioned the Board of Trustees to install electric lights on Dublin and Redwood roads.

TALIHINA, OKLA.—This city just voted waterworks bonds and the agitation has been started for an election to vote electric light bonds.

DUNLAP, IOWA.—An electric light franchise has been granted to L. R. Betts of Council Bluffs and work on installation will be started at once.

PLEASANTON, CAL.—The Livermore Water & Power Company will extend its lines from Pleasanton to Sunol, a distance of about five miles. A.

TOPPENISH, WASH.—The Reservation Electric Company will extend its lines, and install an electric-lighting system in the Yakima Indian district. A.

WAYAUWEGA, WIS.—The electric light plant and flour mill of the Weed and Gumer Company has been sold to C. A. Peterson of this place for $15,600. M.

LITTLE FALLS, MINN.—The Water Power Company is preparing to reconstruct the local dam. The construction will be of crushed rock and cement. C.

MILTON, WIS.—The Milton Water, Light & Power Company has been organized here. Its purpose is to install an electric lighting system in Milton. M.

BINGHAMTON, N. Y.—At a recent election $158,200 bonds were voted, the money to be used for the purpose of erecting a municipal electric street lighting plant.

MENASHA, WIS.—The Lakeside Paper Company has purchased nineteen induction motors from the General Electric Company, of Schenectady, N. Y.

THE DALLES, ORE.—The Hydro-Electric Company, now building a power plant on the Hood River, has been granted a lighting and power franchise at The Dalles. A.

LOS ANGELES, CAL.—A forty-year franchise has been granted to the Pacific Light & Power Company for a transmission line in Los Angeles and Kern Counties.

CHELMSFORD, MASS.—It is expected that the electric lighting service will be installed by the middle of December. The Lowell Electric Light Company will furnish power.

WILMOT, WIS.—An electric light plant will probably be installed here soon by a number of Kenosha, Wis., capitalists. The dam of the local mill will supply the power. M.

SACRAMENTO, CAL.—The Pacific Gas & Electric Company has been granted a franchise by the City Trustees to extend the car lines through the city in four new sections.

CORVALLIS, ORE.—William H. McGoldric has applied to the City Council for a fifty-year franchise for electric light, heat and power. If granted, a power plant will be erected. A.

SEATTLE, WASH.—The electric power plant of the Schwager & Nettleton Lumber Mill Company has been destroyed by fire. The loss is estimated at $25,000. The plant will be rebuilt. A.

LOS ANGELES, CAL.—An electric generating plant will be installed in the New Rosslyn Hotel, to be erected on Main Street. Parkinson & Bergstrom of Los Angeles are the architects. A.

McVILLE, N. D.—The McVille Electric Light & Power Company let the contract for the installation of an electric light plant to the Batter & Flove Electric Company of Milwaukee. C.

SHARON, N. D.—The Sharon Electric Light & Power Company let the contract to the Battery & Globe Electric Company, Milwaukee, Wis., for the installation of a modern lighting plant. C.

POMONA, CAL.—The Southern California Edison Company will install an ornamental lighting system in the Kenoak Tract, and in

Ganesha Park. An underground conduit line will be constructed from Orange Grove Avenue. Engineer Pierce is in charge. A.

HUMBOLDT, IOWA.—Work is being rushed on the steel, cement and stone power house of the Northern Power Company in order to utilize the power from the new dam this winter. C.

MARYSVILLE, CAL.—The Butte Construction Company, of San Francisco, has been awarded the contract for the construction of the arches to be used in lighting the business section of this city.

McMINNVILLE, ORE.—The Yamhill Electric Company has been granted a franchise for a transmission line along the Dayton-Portland road from the corporate limits of Newberg to the county line.

PHILADELPHIA, PA.—The Pennsylvania Equipment Company, of Philadelphia, desires to purchase for immediate delivery from 1,400 to 1,500 feet of 600,000-circular-mile double-braid weatherproof cable.

VISALIA, CAL.—The Pelton Water Wheel Company has been awarded a contract by the Mount Whitney Power Company for the installation of a 2,250 horsepower Pelton-Francis turbine at Power House No. 2. A.

BROWNSVILLE, TEX.—The city has sold $50,000 worth of bonds that were recently voted and will use the proceeds for enlarging the municipal electric light plant and extending the waterworks system. D.

BEAVER CITY, NEB.—Preliminary steps have been taken to organize a stock company and install an electric lighting system. Sufficient money has been subscribed and work on the plant will commence at once.

GLENDALE, CAL.—The city will install a four-light cluster ornamental street-lighting system on Fourth street, Brand Boulevard, and other streets. Manager Lynch, of the municipal lighting plant, is in charge.

COLUMBUS, MONT.—J. P. Pouscaren, civil engineer, has been granted permission by the Secretary of Agriculture to construct dams on the upper Stillwater River and Woodbine Creek to generate 11,000 horsepower. C.

FLORENCE, ORE.—The people have refused to ratify the franchises requested by the Florence-Mapleton Independent Telephone Company, for a telephone service, and the Florence Electric Company for a lighting and power system. A.

TROPICO, CAL.—The Glendale Light & Power Company has offered to furnish the city of Torpico with thirty-two-candlepower street lights, at a cost of $1 each per month, the city to defray the cost of installation, and for all renewals. A.

DAYTON, WASH.—The Pacific Power & Light Company has acquired the Dayton Electric Light Company. The new owners have constructed a power line into the city, from its main transmission, and plan for improvements in the local system. A.

EVERETT, WASH.—The Stone & Webster Engineering Corporation plans for the installation of a power plant in Sultan Canyon. A transmission system will be installed to serve Everett, and the interurban railway system of the company. A.

WALLA WALLA, WASH.—The Pacific Power & Light Company has made application for a lighting and power franchise to cover Walla Walla County. Electric lighting systems will be installed in Wallula, Attalia, Lowden, and other of the smaller sections. A.

MORRIS, MINN.—J. H. Devenney, Dr. George Geenty and J. J. Geib make up a committee to ascertain the cost and feasibility of installing a municipal electric light plant. They have petitioned for an oppropriation for the employment of an electrical expert. C.

WORCESTER, MASS.—The Worcester Electric Light Company has installed a system of ornamental lights along Main Street of this city. The lamps will be left in position for one month so that the people may form an opinion as to the merits of the scheme.

SAN FRANCISCO, CAL.—The stockholders of the Pacific Gas & Electric Company have authorized a bonded indebtedness of $150,000,000 for refunding and improvements. An increase in the common stock of the company to $150,000,000 has also been approved.

BUTLER, OKLA.—The necessary number of contracts for electric lights have been signed and a site for a light plant has been purchased by Messrs. Kise and Mason, the men behind the proposition. Work on the construction of the plant will be started at once.

LEWISBURG, O.—The Lewisburg Lighting Company, incorporated recently, will furnish electric light and power here. The capital of the new concern is $5,000, and its incorporators are D. L. Gaskill, A. C. Robeson, J. M. Bickel, W. T. Fitzgerald and Z. T. Dorman.

TULARE, CAL.—The Tulare County Power Company will build an underground conduit system in the business district in Tulare. The company will inaugurate increased operations on its power plant at Globe, and plans to install the machinery in the early portion of 1912. A.

OAKLAND, CAL.—The Sierra Electric Power Company has been incorporated to operate in the lighting and power business in this vicinity, with a capital stock of $3,000,000. Charles Gross, E. A. Herman, H. L. Breed, and J. E. Bowes, all of Oakland, are incorporators. A.

OWATONNA, MINN.—A. L. Ober of Chatfield, to whom a franchise was voted some time ago, announces that he will now build another electric plant in Owatonna, supplying power from the Zumbro River to Byron, Rochester, Dodge Center, Kasson, Claremont and Owatonna.

TACOMA, WASH.—The Westinghouse Electric & Manufacturing Company is said to have awarded a contract to the Evans-Dickson Company for the installation of electrical apparatus at the Nisqually municipal power plant, and local substation, of the city of Tacoma, at a cost of $25,000. A.

THIEF RIVER FALLS, MINN.—The contract for the installation of Diesel 225-horsepower internal-combustion oil engines and two 150-kilowatt direct-current generators was let to the Northwestern Electric Equipment Company, of St. Paul. The plant will cost complete about $50,000. C.

BEAUMONT, TEX.—The Beaumont Ice, Light & Refrigerating Company, which recently extended its power transmission system to the old field at Spindle Top, is receiving orders for power from a number of the oil concerns that are operating there. This power is used for pumping the wells. D.

DEMING, N. M.—The Blevins-Maynard-Childs Company has been incorporated with a capital stock of $50,000 to construct and operate power plants, pumping plants, and similar enterprises. E. A. Blevins, Silver City; A. B. Maynard, Las Cruces, and A. H. Childs, El Paso, Tex., are incorporators. A.

MUSKEGON, MICH.—This city in company with other cities in Muskegon, Oceana and Newaygo Counties, is making an effort to finance a large power scheme. The scheme involves the joint purchase by the different cities, of the rights of the Wheeler Power Company to a power site on White River.

SAN FRANCISCO, CAL.—Preliminary plans have been made by the Oro Electric Corporation to build a power plant on the Feather River about forty miles north of Oroville and extend its lines through Oroville, Marysville and Sacramento, and eventually to come into Oakland and other bay cities.

DANVILLE, VA.—The location of the city's new electric light plant, which is to be erected at a cost of $150,000, has been approved. The new plant will be located on Bridge Street, on what is known as the old Lee warehouse property, and will be on a much larger scale than the present plant.

WAITSFIELD, VT.—A contract has been made between the town of Waitsfield and the Moody & Almon Electric Company for the latter to furnish electric power and light to the village and to also connect with a number of farms. It is expected that current will be furnished by the end of the month.

TROY, ALA.—The city has closed a contract with the Pea River Power Company for power at a very low price. The Pea River Power Company will build a dam on the Pea River at Elba in Coffee County and from this will be generated the current to supply the needs of the city and private consumers.

LOS ANGELES, CAL.—The Pacific Light & Power Corporation has been granted a forty-year electric light and power franchise from the boundary line between Kern and Los Angeles Counties to the east boundary of the Santa Barbara National Forest Reserve, to points along the San Bernardino base line. A.

SUMAS, WASH.—The bid of the Cascade Trading & Construction Company, in the sum of $772.50, for the erection of poles, and the bid of the Western Electric Company, in the sum of $2,117.54, for electric wire, for the construction of the lighting system of the town of Sumas, have been accepted by the City Council.

SHERIDAN, IND.—J. L. Vickery, who purchased the municipal electric plant, is given fifteen months to equip the plant for a twenty-four hour service. He also promises to build and equip a waterworks plant in connection with a new ice plant. Mr. Vickery will soon be in the market for new machinery and equipment. S.

SAN BERNARDINO, CAL.—The Southern Sierra Power Company has awarded a contract to T. C. Dobbins for the construction of its transmission line from Bishop to San Bernardino. The contract is for labor, and totals $250,000. The company is reported to be planning for the erection of an auxiliary steam plant at Banning, Cal. A.

OSSIAN, IND.—The Town Council has granted a franchise to Reidel and Gray for the construction, equipment and operation of an electric light and power plant for the distribution of current which will be purchased of the Ft. Wayne & Northern Indiana Traction Company. The city will pay $720 a year for twelve street lamps. S.

WAUSAU, WIS.—An agreement has been made between the Wausau Street Railroad Company, the Marathon Paper Mills Company and the Wausau Sulphate Fiber Company for the construction of a joint power line for the concerns named. The line will run from Mosinee to Wausau, thirteen miles, and will be used mainly for cases of emergency.

FALLON, NEB.—W. Cole, project engineer, has been authorized to advertise for sale a lease for electric power which will be transmitted to some point within the city limits of Fallon from the Lahont dam. Bids will be received until December 6. If any satisfactory bid is received the government will build the transmission line from the dam to the city at once.

MARSHALLVILLE, GA.—A contract to furnish the town water

and lights has been awarded to J. C. Walker, president of the Georgia Banking Company, of this city. A stock company capitalized at about $40,000, will carry out this contract. It is understood that work will be begun very soon and that the electric plant will be installed and the waterworks put in within six months.

LIBBY, MONT.—Work on the construction of a power plant at the Yakt Falls, eighteen miles northwest of here, is to start at once, according to J. H. Ehlers, of Spokane. The plans and specifications for the plant have been completed at a cost of $10,000 and are now in Mr. Ehlers' possession. It is the intention to develop 3,400 horsepower, with two generating units of 1,700 horsepower each.

AUSTIN, TEX.—The Austin Electric Company will soon begin the extension of its system to the site of the dam which is soon to be constructed across the Colorado River, a distance of about three miles. The Hydraulic Properties Company of New York, which has the contract for constructing the dam and installing the hydroelectric plant, is now erecting the transmission line from the city to the dam site. D.

ATLANTA, GA.—Officers have been chosen for the Georgia Railway & Power Company which incorporated with a capital of $27,000,000 to unite the hydroelectric plants of the Piedmont section and take over the property of the Georgia Railway & Electric Company. The newly elected officers are as follows: Charles Magee, president; Alex C. King, vice-president; Forrest Adair, secretary and treasurer.

LOUISVILLE, KY.—George H. Harries, president of the Louisville Gas & Lighting Companies, states that H. M. Byllesby & Company, of Chicago, will, in the near future, expend $5,000,000 in the erection of an electric power plant at Cumberland Falls, twenty miles west of Williamsburg, in Pulaski County. Power may be supplied from this plant to Knoxville, Cincinnati, Nashville, Lexington, Louisville, and many smaller cities.

SHELBYVILLE, IND.—The stock and property of the Shelby County Water, Gas & Electric Company has been taken over by the Indiana Service Company, a $10,000,000 concern recently organized to merge and operate plans for the furnishing of gas, electricity and water to the citizens of Anderson, Elwood, New Castle, Greenfield, Batesville and Shelbyville. H. L. Olds and John T. Bacon of Indianapolis are president and secretry, respectively. S.

CINCINNATI, O.—The Hamilton Gas & Electric Company of Hamilton, O., which filed a petition in bankruptcy in the United States Court here and has been placed in the hands of W. A. Everson as a receiver. The liabilties amount to $1,013,856 and the assets are valued at $536,603. The company is one of the oldest in Ohio, having been in operation since 1855. Its embarassment was caused by the City of Hamilton building its own gas and electric plant.

WALLACE, IDAHO.—The Washington Water Power Company is clearing a right of way north of this city for the new power line which is to be run up on Nine Mile. It is expected that the line will be completed in a few weeks and that power then will be furnished for the Tamarack and Chesapeake, Idora Hill and Interstate mines. The power will facilitate greatly the development of these properties and it is expected will also greatly lessen the mining costs.

MILWAUKEE, WIS.—The Milwaukee Electric Light & Railway Company has taken over the water power at Pewaukee, Wis., together with the local electric lighting plant and the lighting contracts of the company. The Milwaukee company will furnish any power that is needed in addition to that supplied by the dam at Pewaukee from its Kilbourn dam on the Wisconsin River. The company has been granted the use of the highways of Pewaukee for erecting its poles and car line. M.

KEOKUK, IOWA.—The Hydraulic Engineering Company of Maine has ordered the following apparatus from the General Electric Company for the Mississippi River Power Company, Keokuk, Iowa: Twelve waterwheel-driven three-phase generators having an aggregate capacity of 108,000 kilowatts; twelve three-phase water-cooled 110,000-volt transformers having an aggregate capacity of 108,000 kilowatts; two waterwheel-driven exciters, one induction-motor-driven generator, and switchboard.

GALVESTON, TEX.—Isidore Newman and son of New Orleans have purchased a controlling interest in the Brush Electric Light & Power Company of Galveston and a new company will be formed to take over and operate the plant. It is announced that about $300,000 will be expended in improvements. The power plant will be enlarged and the lighting system extended. The officers of the old company were H. J. Runge, president; John C. Walker, vice-president; K. C. Mason, secretary-treasurer. Fred M. Lege, Jr., is general manager. D.

MANCHESTER, CAN.—The Manchester Light & Power Company and the South Manchester Light, Power & Tramway Company have been merged in one company under the latter name and with $40,000 capital stock. The directors of the new corporation, which will furnish electric light and power for the villages of Manchester and South Manchester and power for the trolley lines running through the town, are all members of the Cheney family, the silk manufacturers of South Manchester. They are James W., Richard O., Harry G., and Charles Cheney and Frank Cheney, Jr. They were directors of both the merged corporations.

ELECTRIC RAILWAYS.

(Special Correspondence.)

CALGARY, ALTA.—Work has been commenced laying ties for the Chestermere Lake Electric Railway. C.

TAMA, IOWA.—A franchise has been granted to the Tama & Toledo Electric Light & Street Car Company. C.

GRAND FORKS, N. D.—The construction of an electric railway to connect with the Soo Railway is projected. It will be twenty miles long. C.

GRANTS PASS, ORE.—Doyle & Narren are planning for the construction of an electric railway from Grants Pass to Ashland, by way of Medford. A.

MINNEAPOLIS, MINN.—The Electric Short Line Railroad Company has let the contract for grading four miles of road beyond Medicine Lake. C.

HIBBING, MINN.—Victor L. Power has petitioned the Council for a franchise for the installation of an electric line by the Northern Traction Company. C.

PORTLAND, ORE.—Construction is expected to be started on the construction of an electric railway to Canby, Ore., at an estimated cost of $5,000,000. C.

WINNIPEG, MAN.—The E. B. Rease Engineering Company secured control of the Winnipeg Electric Company and will build rural lines through the province. C.

BURGOON, O.—The Fremont & Fostoria Traction Company will install a system of cluster lights for the purpose of lighting the streets of this municipality. Arrangements have been made with the Council. H.

FREMONT, O.—Plans have been arranged for the building of an electric line between this city and Bucyrus, thus connecting Columbus with Toledo. Congressman C. C. Anderson and several associates are back of the project. H.

OSKALOOSA, IOWA.—The Des Moines River Power Company has purchased the Oskaloosa Traction & Light Company and the Oskaloosa & Buxton Electric Railway. A dam capable of developing 10,000 horsepower will be built eight miles below the city. C.

TOLEDO, O.—The right of way of the Toledo, Ann Arbor & Detroit Railroad Company was recently sold at sheriff's sale to George E. Fisher for $2,801. The sale included the route from Toledo to the Michigan state line. The Fidelity Construction Company was plaintiff in the action. H.

NEW HARMONY, IND.—Steps have been taken toward the construction of an interurban line from Poseyville through Swartsville to Mt. Carmel, to connect with the Evansville, Mt. Carmel and Onley road. Meetings are being held and plans made for the early construction of the road. S.

SAN JOSE, CAL.—The San Jose & Almaden Railway Company has been incorporated with a capital stock of $120,000 to build an electric railway from San Jose to New Almaden, a distance of twelve miles. Charles A. Nones, C. P. Anderson, and D. M. Burnett are incorporators. A franchise for the line has been granted. A.

WOODLAND, CAL.—The Sacramento-Woodland Electric Railway Company has awarded a contract for construction on its proposed line from Sacramento to Woodland, to the Dozier Contracting & Engineering Company. By the terms of the agreement the greater portion of the road must be completed by April 15, 1912. A.

TERRE HAUTE, IND.—John W. Ratliff of West Terre Haute, and trustee for Sugar Creek Township, representing a number of coal-mine operators, has filed a petition with the Board of Commissioners of Vigo County for a franchise for the construction of a traction line from West Terre Haute through the coal field to Clinton. The road when built will afford a much needed outlet from the coal fields of that district. S.

TERRE HAUTE, IND.—Articles of incorporation have been filed by the Arcade Realty Company, capitalized at $100,000. The concern is to be the holding company for the Terre Haute, Indianapolis & Eastern Traction Company, which is now building a traction terminal station and office building in Terre Haute. The directors are R. I. Tood, John E. Lamb, John T. Beasley, T. F. Grover and E. J. Davis. S.

CHRISNEY, IND.—The officials of the Evansville, Chrisney & Eastern Traction Company have decided on the routes for the two branch lines out of Booneville. The line to Chrisney will pass through Midway, Spencer County, and the line to Lynnville, which is already surveyed, will run directly north from Booneville. Subsidy elections in three townships will be held November 6. J. P. Chrisney and M. A. Abbot, Chrisney, Ind., are president and secretary, respectively.

HUNTINGTON, IND.—Great interest is being manifested over the announcement that A. B. Terrell & Company, of Chicago, has secured options on the Marion, Bluffton, Geneva and Celina interurban lines and also for the purchase of the Cincinnati, Bluffton and Chicago steam line between Huntington and Portland. A petition signed by a large number of business men has been filed with the Board of Commissioners asking that the franchise contract with the Cincinnati, Bluffton & Chicago road be altered so as to permit electrification. If these plans are carried out a trolley system from Chicago to Cincinnati will probably be joined and constructed in a short time. S.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

BELFIELD, N. D.—The Belfield & Northwestern Telephone Company has been granted a franchise. C.

ELDERON, WIS.—The Elderon Telephone Company is building a line to Wausau, a distance of twenty-five miles. C.

LIBBY, MONT.—The Libby Water Works, Electric Light & Power Company, will install a complete telephone system here at once. C.

ASTORIA, ORE.—The Centennial Telephone Company has been granted a franchise along the county roads between Elsie and Jewell.

SASKATOON, SASK.—The government proposes to install an automatic telephone exchange, to cost $250,000. Work is to be begun without delay. C.

LOS ANGELES, CAL.—The Pacific Telephone & Telegraph Company has completed plans for its new exchange at Garvanza, and is now asking bids for construction.

SAN DIEGO, CAL.—The Postal Telegraph Company will install an underground conduit system in the business district. Plans for the work have been filed with the City Council.

DELANO, CAL.—The Delano-Linn's Valley Telephone Company has been incorporated by Ben Thomas, J. C. Rutledge, A. Villard, P. Girard and R. W. Lockridge with capital stock of $10,000.

REEDLEY, CAL.—A committee consisting of Lucas Keyser, T. M. Lane and Carson Reed, has been appointed to look into the matter of forming a local co-operative telephone company in Reedley.

WAGON MOUND, N. M.—The Ranchers' Telephone Company, recently incorporated, plans for the construction of a number of rural telephone lines in this vicinity. R. K. Odell is commercial agent. A.

MISSOULA, MONT.—The Mountain States Telephone & Telegraph Company will remodel and improve its exchange at Missoula. The company will make improvements in its lines in this district. H. C. Howard is division plant superintendent. A.

EUREKA, CAL.—Through the co-operation of the United States Forest Service, the Hoopa Indian Agency and the California Mining & Dredging Syndicate, the upper Klamath River and the Hooper Section will be connected by telephone with this town.

MADERA, CAL.—The Pacific Telephone & Telegraph Company will install an underground-conduit system on Yosemite Avenue, in compliance with the recent request of the Board of City Trustees. Six cables will be installed. The work is estimated to cost $10,000. A.

NEWPORT, WASH.—The Interstate Telephone Company, Spokane, has purchased the Newport Telephone Company for a consideration of about $25,000. The company, it is said, will make improvements in the present system, and connect with its long-distance lines. A.

SHIRLEY, IND.—The Shirley Telephone Company has incorporated, capitalized at $10,000. The company proposes to build an exchange in Shirley and extend the lines throughout Hancock, Madison and Henry Counties. Thomas O. Wilcoxon, E. M. Wilcoxson and William W. Wilcoxon are directors.

McKINNEY, TEX.—The Union Telephone Company has purchased a building here in which it will establish its headquarters for this district. It has adopted plans for the establishment of a system of long distance lines and local exchanges in the towns of this section. It will spend about $160,000 in these improvements. D.

LAKEVIEW, ORE.—The Lakeview & Pine Creek Telephone Company will construct a new system in the Goose Lake Valley, for a distance of twenty miles. The company has acquired the rural lines at Bunting, Dent, Chandler and Moss, covering territory in New Pine Creek, and Warner Valley. E. C. Thurston is president. A.

LAS CRUCES, N. M.—The board of trustees of Las Cruces has granted the Mountain States Telephone & Telegraph Company a twenty-five-year franchise for its telephone system. The company will entirely rebuild the old system and install modern improvements and equipment. It has purchased a site for new exchange building which it will erect. D.

AUBURN, N. Y.—The local plant of the Auburn Telephone Company, together with the Skaneateles and Allied telephone companies in Onondaga and Cayuga counties, has been sold to the Bell interests through the Friendship Telephone Company, a holding company. These companies have hitherto been independent and were among the larger components of the system of the Federal Tlephone Company, which recently fought the Bell interests successfully, in Rochester.

WALLA WALLA, WASH.—The Pacific Telephone & Telegraph Company plans for the construction of new lines between Walla Walla and Touchet, and between Walla Walla and Colfax. New lines will be built from Prosser to Wallula, and from Prosser to North Yakima. From Arlington to state line points many new lines will be constructed. An addition will be made to the exchange at Waitsburg, and new switchboard panels installed. C. P. Van Houtte is district superintendent. A.

DENVER, COLO.—About $2,000,000 will be expended in 1912 on improvements and expansion of the operating department of the Mountain States Telephone Company. The report is the first to be made since the merger of the Colorado Telephone Company, the Rocky Mountain Bell Telephone Company, and the Tri-State Telephone & Telegraph Company into the Mountain States Telephone & Telegraph Company last July. According to the report, the exchange plant is valued at $14,423,576, and added to this is real estate amounting to $1,871,814, toll plant $5,727,431. The construction now in process is placed at $727,400.

ELECTRICAL SECURITIES.

The Wisconsin Railway Commission has authorized Milwaukee Electric Railway & Light Company to issue $2,000,000 refunding and extension mortgage four and one-half per cent bonds.

The Standard Gas & Electric Company has called for redemption all of its outstanding six-per cent collateral trust notes, which will be paid off at 101 on December 1 by the Continental and Commercial Trust and Savings Bank, of Chicago.

The Public Service Corporation of Northern Illinois, a company comprising the recently merged public utilities of nearby places all controlled by the Commonwealth Edison Company interests, plans a bond issue covering the properties to retire existing bonds by purchase of ultimate exchange and also for additions and betterments. The initial offering will likely be about $4,250,000. Merged concerns include North Shore Electric Company, Economy Light & Power Company, Illinois Valley Gas & Electric and others.

The Westinghouse Electric & Manufacturing Company has notified holders of its assenting stock that the name of that security has been changed to common stock. This change, which involves no change in stockholders' rights, was made because all of the stock of the company outstanding, other than the preferred, consists of the so-called assenting stock, and that it is in fact common stock. New stock certificates will be exchanged on presentation of old certificates at the offices of the Union Trust Company, Pittsburgh, Pa.; United States Mortgage and Trust Company, New York, and the New England Trust Company, Boston.

DIVIDENDS.

American Telegraph & Cable Company; regular quarterly dividend of one and one-quarter per cent, payable December 1 to stock of record November 30.

Federal Utilities (Inc.); regular quarterly dividend of one and one-half per cent on the preferred stock, payable December 1 to stockholders of record November 15.

Northern Texas Traction Company; quarterly common dividend of $1.50 a share, payable December 1 to stock of record.

Portland Railway, Light & Power Company; quarterly dividend of one per cent, payable December 1.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES IN THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEKS.

NEW YORK.	Nov. 6.	Oct. 30.
Allis-Chalmers common	3	2¾
Allis-Chalmers preferred	10½	10
Amalgamated Copper	55	52¼
American Tel. & Cable	*74	*74
American Tel. & Tel.	136	134
Brooklyn Rapid Transit	76½	73⅞
General Electric	151	47¼
Interborough-Metropolitan common	15	14½
Interborough-Metropolitan preferred	45⅝	44½
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common	85	84
Mackay Companies (Postal Telegraph and Cables) preferred	72⅝	72½
Manhattan Elevated	135¼	134
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	47⅝	43½
U. S. Steel common	59⅜	52⅝
U. S. Steel preferred	109¾	104⅛
Western Union	78½	77
Westinghouse common	64⅝	63
Westinghouse preferred	*111	*111

*Last price quoted.

BOSTON.	Nov. 6.	Oct. 30.
American Tel. & Tel.	136⅛	133⅞
Edison Elec. Illuminating	287	287
General Electric	151	147¼
Massachusetts Electric common	21¼	20¾
Massachusetts Electric preferred	94	93
New England Telephone	144	143
Western Tel. & Tel. common	27⅛	26½
Western Tel. & Tel. preferred	106½	104¾

PHILADELPHIA.	Nov. 6.	Oct. 30.
American Railways	44	43¾
Electric Company of America	11⅞	11¾
Electric Storage Battery common	52¾	52
Electric Storage Battery preferred	52¾	52
Philadelphia Electric	16⅜	16¼
Philadelphia Rapid Transit	23	22⅜
Philadelphia Traction	85	83¼
Union Traction	51	50¼

CHICAGO.	Nov. 6.	Oct. 30.
Chicago Elevated Railways common	27	28
Chicago Elevated Railways preferred	90½	93
Chicago Railways, Series 1	95	92
Chicago Railways, Series 2	31¼	30½
Chicago Subway	⅞	1
Chicago Telephone	121	121
Commonwealth Edison	132½	129
National Carbon common	101½	101½
National Carbon preferred	117	118

PERSONAL MENTION.

D. W. REEVES has been appointed manager of the Tehama County Telephone Company at Red Bluff, Cal.

C. C. SIMONSON has been appointed manager of the Citizens' Electric Company at Lewiston, Mont., succeeding N. C. Carwile.

T. D. SMITH, formerly with the Commercial Electric Company, St. Louis, is now in charge of the electrical department of the Mexico Mine & Smelter Supply Company, at Mexico City.

EDWARD J. NALLY, first vice-president and general manager of the Postal Telegraph-Cable Company, New York, is making an annual tour of inspection of the company's Pacific Coast properties.

N. H. BROWN has been made head of the Electrical Engineering Department of the University of Texas, in succession to A. C. Scott. J. W. Ramsey has been appointed instructor in the same department.

CHAUNCEY L. HIGHT has been placed in charge of the New York office of Henry Sears Company, of Boston. Mr. Hight is quite well known as a representative of that company and has a wide acquaintance in the electrical field.

BRUCE W. BENEDICT, for several years in the motive power department of the Atchison, Topeka & Santa Fe Railway, has been appointed director of the shop laboratories in the department of mechanical engineering at the University of Illinois.

GEORGE M. KUEMMERLEIN, who for the past twelve years has been superintendent of the Milwaukee Electric Railway & Light Company's Racine property, has retired and will in the future live in Milwaukee. Mr. Kuemmerlein is well known in Milwaukee electrical circles.

EDWIN HAWLEY has announced his resignation as president of the Great Western Power Company, of the California Electric Generating Company and of the Western Power Company. It is understood that Mr. Hawley's resignations are due to a desire to lessen his official duties. He will remain a director and member of the Executive Committee of each corporation.

SIR OLIVER LODGE has become associated with the Marconi's Wireless Telegraph Company, of London, as scientific adviser. This arrangement has grown out of the settlement of the patent controversy between this company and the Lodge-Muirhead Syndicate, another result of which is the taking over of all the Lodge-Muirhead wireless-telegraph patents by the Marconi interests.

OBITUARY.

SHERMAN CULP, president of the Sandusky, Norwalk & Mansfield Electric Railway Company, died recently at his home in Norwalk, O., of Bright's disease.

DANIEL D. DRAWBAUGH, who claimed to be the original inventor of the telephone, died at his home near Harrisburg, Pa., November 2, at the age of eighty-four. For the last month he had been at work on a new burglar alarm. He was seized with an attack of apoplexy while in his laboratory. Mr. Drawbaugh, whose occupation was the repairing of clocks and guns, conceived the idea of the electrical transmission of speech in 1860 and in 1869 or 1870 he claimed to have invented a transmitter and made a complete operative instrument.

NEW INCORPORATIONS.

JAMESTOWN, N. Y.—The Hoosier Sales Company has been incorporated by F. L. Wyman, S. H. Renfield and B. S. Dean to manufacture electrical goods. The capital of the concern is $150,000.

NEW YORK, N. Y.—The Gallagher-Tompkins Company has been incorporated with a capital of $175,000 to manufacture electrical machinery. George D. Zahm, F. Bianchi Tompkins and Richard W. Gallagher are interested.

NEW YORK, N. Y.—The Aerocutta Company has been incorporated by Samuel Lewis, Andrew Anderson, Jr., William A. Winter and Louis F. White, with a capital of $10,000. The company will manufacture electrical machines, etc.

CHICAGO, ILL.—The West Hammond Gas & Electric Company has been incorporated with a capital of $5,000 to furnish light, heat and power. At the head of the project are Harry W. Darling, George F. Borman and Jefferson L. Fulton.

SYRACUSE, N. Y.—The Waite-Hayden Company has been inporated with a capital of $10,000 to manufacture time clocks and electrical signals. The incorporators are Charles P. Wortman, William M. Waite, Perry B. Hayden and Annie S. Waite.

EVANSVILLE, IND.—The Bowles Photo & Engraving Lamp Company has incorporated with a capital stock of $50,000. The company will manufacture an electric lamp for photographic and other engraving work. John C. Zutt, Emil Weil and Will Gleichman are directors. S.

GOSHEN, IND.—The Modern Specialties Manufacturing Company has incorporated to manufacture and deal in all kinds of machinery, tools, appliances, mechanical and electrical devices and specialties. The capital stock is $25,000. Clinton C. Tiedmann, John Winter, Elmer E. Ash and J. Albert Snapp, are directors. S.

INDIANA HARBOR, IND.—The Central Auto Manufacturing Company has incorporated to manufacture and deal in all kinds of automobiles, mechanical and electrical supplies and to construct, equip and operate a plant to conduct the business. Clifford C. Robinson, Francis E. Stephens and Boyd S. Gardner are directors.

ANDERSON, IND.—The Remy Electric Company, which recently acquired the interests and patents of the American Headlight Company of Indianapolis, has also purchased the property and patents of the R. G. Peters Company of Grand Rapids, Mich., manufacturers of headlights. The property will be removed to this city. S.

BEAUMONT, TEX.—The Stone & Webster Engineering Corporation of Boston, Mass., has closed its option on the property of the Beaumont Ice, Light & Refrigerating Company. This transaction does not embrace the refrigerator plant, but involves the electric light and power plant. It is stated that this deal is the first step on the part of the Stone & Webster Engineering Corporation to construct an interurban electric railway between Beaumont and Port Arthur, a distance of twenty-five miles. Important improvements will be made to the light and power plant. D.

NEW PUBLICATIONS.

MAGNETIC OBSERVATIONS.—The United States Coast and Geodetic Survey has published results of observations made at Baldwin, Kan., 1907-1909. Hourly values of declination and of horizontal and vertical intensity are given, as well as monthly and annual averages. Diurnal variations and instruments are described. There are also a large number of diagrams illustrating magnetic storms.

COALS OF WASHINGTON.—The United States Geological Survey has published Bulletin 474 on "Coals of the State of Washington." The coal of the State ranges from the lowest grade subbituminous to anthracite. The anthracite is not now used for lack of transportation facilities. Though the demand for anthracite for domestic purposes is great, the prevailing price is so high that the better grades of bituminous coal must be utilized instead.

METALLIC TITANIUM.—This publication which was sent out by Rensselaer Polytechnic Institute, Troy, N. Y., takes up the various methods of isolating the pure metal. The process of reduction of the titaniflourides by the alkali metals, reduction of titanium dioxide by carbon and the reduction of titanium tetrachloride with sodium are each treated briefly. The melting point of the pure metal was found by Matthew A. Hunter, the author, to be comparatively low; within 100 degrees of that of platinum.

NEW LAMP ASSOCIATION BULLETINS.—The Engineering Department of the National Electric Lamp Association has issued under date of September 1, Bulletin 12A on the electric lighting of automobiles, and Bulletin 8C on miniature carbon lamps. The former describes various systems of current supply, giving wiring diagrams showing the arrangement of each system, and reproduces photographs of a number of reflectors. The subject is gone into quite thoroughly. The latter publication shows numerous shapes of miniature lamps with a brief description of each.

REPORTS ON STREAM FLOW.—The United States Geological Survey has announced the publication of four reports on the flow of streams in the United States. They are designated as Water-Supply Papers 265, 266, 267, and 268. The first mentioned relates to rivers in Minnesota, Wisconsin, North Dakota, Illinois, and Iowa, which drain either into the Mississippi River or northward into Canada. The second relates to rivers draining into the Missouri, the streams being located in Montana, Wyoming, North Dakota, Colorado, Nebraska, and Missouri. The third comprises those streams draining into the lower Mississippi mainly through Arkansas and Red Rivers, the streams being located in Colorado, New Mexico, Arkansas, Missouri, and Mississippi. The fourth gives information concerning streams draining into the western part of the Gulf of Mexico, such as the Rio Grande and the Pecos. The records contained in these reports show the flow of the rivers for each day during the year 1909 and they furnish an account of the water resources available for use in the regions in which the records were made.

COPPER WIRE TABLES.—The Bureau of Standards, Washington, D. C., has prepared Circular No. 32 at the request of the Standards Committee of the American Institute of Electrical Engineers. In its preparation the Bureau has had the co-operation of that committee and the tables have been adopted as official by the Institute. The circular discusses the results of work recently completed at the Bureau on the temperature co-efficient and the conductivity of copper, and gives a history of wire gauges, showing that the trend of practice is toward expressing diameter directly in decimal fractions of an inch. There are fifteen tables, including complete reference tables for standard annealed copper, American Wire Gauge, both in English and in metric units; and tables for bare concentric cables of standard annealed copper and for hard-drawn aluminum wire. The tables also include comparisons of wire gauges, and tables of temperature reductions, with complete explanations. Four appendices give information on the units used in the expression of resistivity; on the calculation of the "resistivity-temperature constant" and on the expression of the temperature coefficient; on the density of copper; and on the calculation of the resistance and mass per unit length of cables.

LEGAL NOTES.

REMOVAL OF POLE LINES.—The State Supreme Court has reversed a decision of the Superior Court of Tehama County in ruling that the Northern California Power Company need not remove its pole line from the property of plaintiff, W. H. Gurnsey, who brought suit to eject the company from his property, which has been used by the public as a highway for a period of forty years. Having been granted a franchise over the roads of the county by the Board of Supervisors, the Northern California Power Company deemed the property a public road and so constructed its line. The Superior Court ruled that line should be removed, and in a reversal of such decision the Supreme Court holds that the company could condemn a right of way through private property, and that removal of line is not necessary, but that the Northern California Power Company is open to action for damages by plaintiff. A.

REQUIREMENTS OF PURCHASER OF MUTUAL TELEPHONE COMPANY STOCK.—Where a man bought from a renter a share of mutual telephone company stock for $10 and attached his telephone to the wires, without the consent of the officers, the Supreme Court of Kansas holds that it was error to dissolve an injunction against his using such wires. It says that the purchase of the stock by the man operated as a transfer of the title as between the seller and himself, but it did not necessarily complete his right to the benefits of a stockholder so far as the company was concerned. His attaching a telephone to the company's wires without the consent of the officers was in direct violation of the by-laws. There was still another provision that it was incumbent on one who was not a charter member to pay a sum equal to $25 before he could attach a telephone to the line, and that all persons wanting connection on the line, after the adoption of the constitution and by-laws, should be required to pay $25. He was deemed to have purchased the stock with a knowledge of these by-laws and to be bound by them. Before one who purchases stock from a stockholder and member of a corporation is entitled to have the shares transferred and to have the rights and privileges of a member of the corporation, he must comply with the statutes, by-laws, and regulations governing such transfers and the admission of new members.—Star Mutual Telephone Company vs. Longfellow, 116 Pac. R. 506.

IMPRISONMENT FOR CRIMINAL NEGLIGENCE ON GERMAN TRANSMISSION LINE.—An interesting case showing the rigor of German court procedure in criminal cases was cited in the *Zeitschrift fur Electrotechnik und Maschinenbau*, Potsdam, Germany, October 19, 1911. Some repairs had to be made to a 6,000-volt overland transmission line, involving the setting of new poles, rearrangement of wires, etc. Although the authorities in charge of the system had ordered the power cut off the line during the work, an agreement was reached between the chief operator at the power house and the foreman of the construction gang that the power should be cut off only between 12 and 1 o'clock each noon, at which time the actual work on the wires would be done. On two successive days the foreman sent one of his gang on a bicycle to the nearest transformer to determine whether the power was positively off before beginning work on the circuit. On the third working day the foreman set his watch to agree with the power-house time and shortly after 12 o'clock sent one of his linemen up a pole without further preliminaries. Before tying himself to the pole as a safeguard the man came in contact with the circuit, which was still "live," received a severe shock and burn and fell to the ground, dying soon afterward. It developed at the investigation which followed that the operator had not cut off the line until 12:08 o'clock. The operator and the foreman were both tried on the charge of criminal negligence and found guilty. The operator was sentenced to imprisonment for one month and the foreman for only two weeks, as circumstances were held to be extenuating.

RULE AGAINST USING OTHER KINDS OF LIGHTS UNREASONABLE.—A mercantile concern, which had been using sufficient electricity to run seven electric lights, put in a different system of lighting with gas, but desired to retain the electric light system to be used by them as they might have occasion, by paying therefor in proportion to the amount of electricity used, according to the established rate, or a minimum charge of $2.00 per month, in accordance with the accustomed rules of the light company. This the light and power company refused to allow, requiring that the concern either abandon the other system, or its electric system would be disconnected. This demand was based on a rule of the company that persons using its lights must use no other kind of lights which it claimed had been violated by putting in the system of gas lighting which it was desired to use in connection with the electric system. But the Court of Civil Appeals of Texas affirms a judgment holding that the company must restore the connection and continue to furnish light. The court says that the effect of such a rule, if enforced, can easily be seen. The tendency would be to drive one or the other of the systems out of business, and to give the one remaining a monopoly of the business. If the company had the right to impose this condition as to the use of gas, it would have equally the right to impose it as to the use of kerosene lamps or candles, and thus compel all of its customers to use its lights alone, or do without its service entirely. Such a rule or regulation is on its face unreasonable and could not be enforced.—Nacogdoches Light & Power Company vs. Thomas & Richardson, 138 S. W. R. 1080.

INDUSTRIAL ITEMS.

THE UNDERWRITERS' LABORATORIES, INC., Chicago, Ill., has sent out cards announcing the tenth anniversary of its corporate existence, and extending an assurance of its continued cooperation to all those laboring for a reduction in the fire waste.

THE DELTA-STAR ELECTRIC COMPANY, Chicago, Ill., is furnishing a large number of specially designed high-voltage series transformers for the Chicago street lighting flame-arc circuits. These transformers are manufactured by the Pittsburgh Transformer Company.

THE SHELBY ELECTRIC COMPANY of Shelby, O., is distributing two booklets dealing respectively with industrial lighting and the lighting of retail stores. Both of these bulletins take up their subjects from the standpoint of the layman rather than of the illuminating engineer and are replete with a number of suggestions and illustrations of successful installations.

A. EUGENE MICHEL, advertising engineer, announces that his offices have been moved into the Park Row Building, 21 Park Row, New York, where larger space has been secured, as necessitated by constantly increasing business. Temporarily the retouching and illustrating department will remain in the Hudson Terminal Buildings, but all business will be managed from the new offices.

WESTINGHOUSE, CHURCH, KERR & COMPANY, New York, N. Y., has published a booklet illustrating by a few examples the many problems, outside of those relating to main generating equipment, which enter into effective power plant design and construction. A number of photographs of plants have been reproduced and a brief tabulated description of the special features of each is given.

ROTH BROTHERS & COMPANY, Chicago, Ill., has recently shipped to the Wagner Manufacturing Company, of Sidney, O., manufacturer of aluminum ware, ten five-horsepower polishing motors of a new, improved, ventilated type which the company has recently placed on the market. All ten machines will be used for polishing the aluminum utensils manufactured by the Wagner company.

ALLGEMEINE ELEKTRICITAETS-GESELLSCHAFT, Berlin, Germany, has prepared a bulletin dealing with the subject of electric welding by means of an arc. Two methods are described, one in which use is made of a carbon electrode, and a second in which an electrode of the material to be welded is employed. The generator used is illustrated together with a number of welds which have been made.

THE NORMAN W. HENLEY PUBLISHING COMPANY, New York, N. Y., has prepared isometric drawing paper in the form of pads and also in loose sheets. The lines are ruled in green ink in three main directions, vertical, horizontal and thirty degrees from the horizontal, permitting isometric sketches or drawings to be made very quickly and with little trouble. The company is the sole maker of this paper.

THE NORTHERN EQUIPMENT COMPANY, Chicago, Ill., announces that it has completed a sales arrangement for its Copes boiler-feed regulators and Copes pump governors with Dravo-Doyle Company, merchant engineers of Pittsburgh, Pa., who have recently established a steam specialty department, with headquarters in Pittsburgh, covering the Pittsburgh, Cleveland, Philadelphia, Chicago and West Virginia territories.

THE PETERSON ENGINEERING COMPANY, New York, N. Y., has issued a booklet describing the Economy elevator-guide lubricator. The catalog describes a new method of lubricating elevator guides in which a thin strip of grease is applied exactly where the shoes bear on the rails and for every trip of the car. Several different types are described suitable for steel and wooden rails and also for counter weight guides. Interesting data are given of tests made on elevators equipped with the Economy lubricator.

H. W. JOHNS-MANVILLE COMPANY has found it necessary, due to the fast increasing business in Birmingham, Ala., to change the location of its office in that city from 1220 Empire Building to 606 Chamber of Commerce Building, this address being better adapted for the company's requirements. This office will continue under the management of W. H. Fleming, who is well known throughout this section of the country, having been connected with the New Orleans branch of this company for a considerable time.

THE DUPLEX METALS COMPANY, Chester, Pa., compares iron ground rods with copper-clad ground rods in an advertising folder which was recently mailed. The comparison is made by a photographic reproduction of the two rods as they appear after having been in the ground for some time. The rods are shown in position, the earth being dug away so as to expose them to view, and the apparent corrosion of one of them compared with the unaffected condition of the other enables the reader easily to "Guess which of them is Copper Clad."

THE WHEELER CONDENSER & ENGINEERING COMPANY, Carteret, N. J., devotes its Bulletin 107 to a discussion of high-vacuum jet condensers. The Wheeler rectangular jet condenser to which a large part of the bulletin is devoted is constructed on the counter-current principle, the arrangement of water trays, baffles, air outlet, exhaust steam inlet, etc., being such that the enormous volume of low-pressure steam exhausted from a turbine is efficiently handled with the minimum consumption of water, and the mini-

mum consumption of power on the part of the tail pump. A number of installations of this type of condenser are illustrated.

THE BUCKEYE ELECTRIC COMPANY, Cleveland, O., has reproduced in a folder two pictures of a printing establishment in which the lighting was greatly improved by a Buckeye salesman co-operating with the local lighting plant. As set forth in this folder a strong feature of the Buckeye organization is the fact that the salesmen are able to solve illuminating problems without having to wait for engineering advice. A strong engineering department is, however, maintained for the consideration of those problems too important to be solved off hand even by an expert.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Pittsburgh, Pa., describes in leaflet No. 2,373, its No. 303-A box-frame interpole motor. Complete specifications for the motor, brief descriptions of the important parts, and performance curves are given on the sheet. Particular stress is laid upon the fact that the motor is equipped with axle-bearing dust guards, which prevent the entrance of dirt and sand into the axle bearings, and thereby greatly prolong the life of bearings and gears. Descriptive-leaflet No. 2,374, mailed at the same time, gives specifications and brief descriptions of the parts of the company's box-frame interpole railway motor No. 310-C.

SCHUTTE & KOERTING COMPANY, Philadelphia, Pa., has taken up in detail in Catalog 5 its eductor and induction condensers. In these condensers the exhaust steam enters with the cooling water, and the process of condensing being completed, the jet has to be discharged against atmospheric pressure. The mechanical work is done by the water jet which enters the chamber as a solid jet and discharges with sufficient velocity to overcome the pressure of the atmosphere. Each type has its own special use and these are fully described in the catalog. Koerting centrifugal spray nozzles for recooling water are described in Catalog 6, issued by the same company.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has mailed a number of publications superseding former bulletins and describing new types of machinery and apparatus. Bulletin No. 4,883 is devoted to the general principles of the turbine and the construction of both the turbine and the generator. The bulletin contains numeros illustrations of turbine and generator parts, as well as complete representative installations. Bulletin No. 4,885 describes a new meter designed for accurately measuring the power used by relatively small consumers. The meter is designed for five and ten-ampere circuits. The subject of electricity in coal mines is discussed in Bulletin No. 4,886, and the advantages of electric power in mine installations taken up. Numerous photographs are shown. Bulletin No. 4,894 describes cylinder controllers for railway service. This bulletin supersedes the company's previous bulletin on this subject. In Bulletin No. 4,889 two types of a machine for grooving the commutators of railway motors are illustrated and described. Bulletin No. 4,860 is published for the purpose of giving a brief outline of the fundamental principles of electro-metallurgy and its principal applications, and to aid prospective buyers in the selection of proper apparatus for the most common branches of the art without introducing descriptions of the more intricate processes or unnecessary technical data. The bulletin illustrates and describes, in considerable detail, generators of various capacities for this work. Bulletin No. 4,891 is composed principally of illustrations of electrical equipment of various railways throughout the country.

DATES AHEAD.

Alabama Light and Traction Association. Montgomery, Ala., November 14 and 15.

Ohio Society of Mechanical, Electrical and Steam Engineers. Canton, O. November 17 and 18.

Association of Railway Telegraph Superintendents. Joint meeting of eastern and western divisions, Chicago, Ill., November 23 and 24.

Los Angeles Electrical Exposition. Los Angeles, Cal., November 25-December 9.

American Physical Society. Regular Thanksgiving meeting, Chicago, Ill., December 2, 1911.

National Gas and Gasoline Engine Trades Association. Annual meeting, Hotel Hollenden, Cleveland, O., December 5-8.

American Institute of Chemical Engineers. Annual meeting, Washington, D. C., December 20-22.

National Electric Light Association. Next annual convention, Seattle, Wash., June 10-14, 1912.

National Electrical Contractors' Association. Annual meeting, Denver, Colo., July 17-20, 1912.

The 1912 Boston Electric Show. Mechanics Building, Boston, Mass., September 28-October 26, 1912.

Directory of Electrical and Allied Engineering and Scientific Societies

(Published in the second issue of each month.)

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary, George S. Emery, 11 North Royal Street, Mobile, Ala.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Secretary, L. O. Howard, Smithsonian Institution, Washington, D. C.

AMERICAN ASSOCIATION OF ELECTRIC MOTOR MANUFACTURERS. Secretary, W. H. Tapley, 29 West Thirty-ninth Street, New York, N. Y.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, H. C. Donecker, 29 West Thirty-ninth Street, New York, N. Y. Affiliated societies: American Electric Railway Accountants' Association, secretary, H. E. Weeks, Davenport, Iowa; American Electric Railway Claim Agents' Association, secretary, B. B. Davis, Columbus Railway & Light Company, Columbus, O.; American Electric Railway Engineering Association, secretary, Norman Litchfield, New York, N. Y.; American Electric Railway Transportation and Traffic Association, secretary, H. C. Donecker, 29 West Thirty-ninth Street, New York, N. Y.; American Electric Railway Manufacturers' Association, secretary, George R. Keegan, 2321 Park Row Building, New York, N. Y.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, J. W. Richards, South Bethlehem, Pa.

AMERICAN ELECTROTHERAPEUTIC ASSOCIATION. Secretary, John Travell, 17 East Eleventh Street, New York, N. Y.

AMERICAN FOUNDRYMEN'S ASSOCIATION. Secretary, Richard Moldenke, Watchung, N. J.

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AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West Thirty-ninth Street, New York, N. Y.

AMERICAN INSTITUTE OF MINING ENGINEERS. Secretary, Rossiter W. Raymond, 29 West Thirty-ninth Street, New York, N. Y.

AMERICAN IRON AND STEEL INSTITUTE. Secretary, W. J. Filbert, 30 Church Street, New York, N. Y.

AMERICAN MATHEMATICAL SOCIETY. Secretary, F. N. Cole, 30 West One-Hundred-and-Sixteenth Street, New York, N. Y.

AMERICAN PHYSICAL SOCIETY. Secretary, Ernest Merritt, Cornell University, Ithaca, N. Y.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION. Secretary, J. W. Taylor, Old Colony Building, Chicago, Ill.

AMERICAN ROENTGEN-RAY SOCIETY. Secretary, G. C. Johnson, 514 Bijou Building, Pittsburgh, Pa.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary, Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF CHEMICAL ENGINEERS. Secretary, John C. Olsen, Polytechnic Institute, Brooklyn, N. Y.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Secretary, Charles Warren Hunt, 220 West Forty-seventh Street, New York, N. Y.

AMERICAN SOCIETY OF ENGINEER DRAFTSMEN. Secretary, Harry L. Slogan, New York, N. Y.

AMERICAN SOCIETY OF ENGINEERING CONTRACTORS. Secretary, Julius R. Wemlinger, 626 Park Row Building, New York, N. Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 29 West Thirty-ninth Street, New York, N. Y.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, A. P. Folwell, 239 West Thirty-ninth Street, New York, N. Y.

AMERICAN SUPPLY AND MACHINERY MANUFACTURERS' ASSOCIATION. Secretary, F. D. Mitchell, 309 Broadway, New York, N. Y.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, E. Hardin, Hot Springs Water, Gas & Electric Company, Hot Springs, Ark.

ARKANSAS INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Charles F. Speed, Texarkana, Ark.

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ASSOCIATION OF ENGINEERING SOCIETIES. Secretary, Fred Brooks, 31 Mills Street, Boston, Mass.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, James Farrington, La Belle Iron Works, Steubenville, O.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary, J. Andreucetti, Chicago & Northwestern Railway, Chicago, Ill.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, J. W. Drew, Minneapolis, St. Paul & Sault Ste. Marie Railroad, Chicago, Ill.

CALIFORNIA ELECTRIC RAILWAY ASSOCIATION. Secretary, L. E. W. Pioda, Oak and Broderick Streets, San Francisco, Cal.

CALIFORNIA STATE ASSOCIATION OF ELECTRICAL CONTRACTORS. Secretary and treasurer, F. V. Meyers, 502 Grant Building, San Francisco, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, Confederation Life Building, Toronto, Canada.

CANADIAN STREET RAILWAY ASSOCIATION. Secretary, Acton Burrows, 157 Bay Street, Toronto, Canada.

CENTRAL ELECTRIC RAILWAY ASSOCIATION. Secretary, A. L. Neereamer, Traction Terminal Building, Indianapolis, Ind.

CENTRAL ELECTRIC TRAFFIC ASSOCIATION. Secretary, J. T. Brittson, Chicago, South Bend & Northern Indiana Railway Company, South Bend, Ind.

CLEVELAND ELECTRICAL LEAGUE. Secretary, T. P. Cagwin, Cleveland Telephone Company, Cleveland, O.

COLORADO ELECTRIC CLUB. Secretary, C. F. Oehlmann, P. O. Box 922, Denver, Colo.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION. Secretary, F. D. Morris, Colorado Springs, Colo.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, F. W. Poole, Bridgeport, Conn.

ELECTRIC CLUB OF CHICAGO. Secretary, N. F. Obright, 1825 American Trust Building, Chicago, Ill.

ELECTRIC VEHICLE AND CENTRAL STATION ASSOCIATION. Secretary, H. T. Sands, 133 Pleasant Street, Malden, Mass.

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ELECTRICAL CREDIT ASSOCIATION OF PHILADELPHIA. Secretary, John W. Crum, 1324 Land Title Building, Philadelphia, Pa.

ELECTRICAL CREDIT ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliot, Harding Building, San Francisco, Cal.

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ELECTRICAL MANUFACTURERS' CLUB. Secretary, Walter Cary, Westinghouse Lamp Company, New York, N. Y.

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FRANKLIN INSTITUTE. Secretary, R. B. Owens, 15 South Seventh Street, Philadelphia, Pa.

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ILLUMINATING ENGINEERING SOCIETY. Secretary, Preston S. Millar, Engineering Societies Building, 29 West Thirty-ninth Street, New York, N. Y.

INDEPENDENT ELECTRICAL CONTRACTORS' ASSOCIATION OF GREATER NEW YORK. Secretary, L. H. Woods, 2355 Jerome Avenue, New York, N. Y.

INDEPENDENT TELEPHONE ASSOCIATION OF MISSISSIPPI. Secretary and treasurer, J. B. Shannon, New Albany, Miss.

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MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass.

MASTER CAR BUILDERS' ASSOCIATION. Secretary, J. W. Taylor, 390 Old Colony Building, Chicago, Ill.

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NATIONAL ELECTRICAL INSPECTORS' ASSOCIATION. Secretary, T. H. Day, 27 Pine Street, Hartford, Conn

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary, Franklin H. Wentworth, 87 Milk Street, Boston, Mass.

NATIONAL GAS AND GASOLINE ENGINE TRADES ASSOCIATION. Secretary, Albert Stritmatter, Cincinnati, O.

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NEBRASKA ELECTRICAL ASSOCIATION. Secretary, S. J. Bell, David City, Neb.

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NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, Engineering Societies Building, 29 West Thirty-ninth Street, New York, N. Y.

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WISCONSIN ELECTRICAL ASSOCIATION. Secretary, George Allison, Milwaukee Electric Railway & Light Company, Milwaukee, Wis.

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WISCONSIN STATE TELEPHONE ASSOCIATION. Secretary, Paul J. Weirich, Monroe, Wis.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) October 31, 1911.

1,007,054. CEILING ROSE AND THE LIKE FOR USE IN ELECTRIC CIRCUITS. Frederick George Bazell, Coventry, England, assignor to Arthur Crowther, Loxley, Leeds, England. Filed Dec. 18, 1909. Consists of a base connected with the molding, a body secured thereto and provided with terminal connections, and a cap through which the drop cord passes.

1,007,058. MECHANICAL MOVEMENT AND ELECTRIC LIGHT SOCKET. Tonjes August Carl Both, New York, N. Y., assignor to Ida S. Rosenheim, New York, N. Y. Filed June 2, 1911. The key for the socket is actuated by a Z-shaped cam and a spring.

1,007,069. TREATMENT OF IRON OR STEEL TO PREVENT THE OXIDATION OR RUSTING THEREOF. Thomas Watts Coslett, Birmingham, England. Filed Nov. 25, 1910. Consists in subjecting the iron as the cathode to the action of a zinc-containing solution of phosphoric acid through which an electric current is passed.

1,007,122. ADJUSTABLE HOLDER FOR REFLECTORS. George Loring, Cleveland, Ohio. Filed June 25, 1908. Combined with an electric lamp socket is a member encircling the socket, means mounted upon the member for adjustably engaging the socket, a second member adjustably mounted upon the first member, a reflector, and means mounted upon the second member for adjustably engaging the reflector.

1,007,125. ELECTRIC HEATER. Charles P. Madsen, Chicago, Ill., assignor to Pelouze Electric Heater Co., Chicago, Ill. Filed July 9, 1910. An electric toaster consists of a resistance strip wound and supported to lie in a single plane above a heat-reflecting and insulating base and directly beneath a food grid.

1,007,138. INSULATOR BRACKET. Charles L. Peirce, Jr., Pittsburgh, Pa., assignor to Hubbard & Co., Pittsburgh, Pa. Filed Oct. 26, 1910. A vertical iron plate with holes for attachment to the wall has a corrugated rib to which iron insulator brackets may be riveted.

1,007,151. ELECTRODE. Eben C. Speiden, Niagara Falls, N. Y., assignor to International Acheson Graphite Co., Niagara Falls, N. Y. Filed May 17, 1910. A hollow box-like electrode has its four sides made of board-like, overlapping, conducting slabs intermeshed at the ends.

1,007,177. TIME-CONTROLLED ELECTRIC FIRING MACHINE. Harry L. Bevans and Hugh D. Bevans, Mulberry, Kan. Filed May 13, 1910. Each of two charge-firing mechanisms comprises a switch and a starting magnet connected to a firing circuit so that the second mechanism is operated at a predetermined time interval after the first mechanism.

1,007,178. PRESSURE-RATIO ALARM. Asa White Kenney Billings, Habana, Cuba. Filed July 21, 1909. Combined with controlling means responsive to the ratio of two varying differences of pressure is a circuit-closer operable at certain predetermined conditions of the controlling means and electric alarms operable by the circuit-closer.

1,007,186. ELECTRIC REGULATION. John L. Creveling, New York, N. Y., assignor to Safety Car Heating & Lighting Co. Filed June 21, 1911. An electric car-lighting system comprising a generator, storage battery, lamp-circuit regulator and generator regulator, has the two regulators interconnected so as to secure proper voltage regulation.

1,007,192. MAGNETIC CONTROL SYSTEM FOR RAILWAYS. Austen H. Fox, New York, and Arnold W. Lenderoth, Stapleton, N. Y. Filed May 22, 1909. Includes a series of differentiated armatures on the roadway, and means including a movable magnet whose posture on the vehicle is affected differently by the several armatures, for giving an indication when certain predetermined speeds are exceeded.

1,007,196. MEANS FOR REVERSING EXPLOSION MOTORS. Ole Gravdahl, Christiania, Norway, assignor to Herman Levanger, Christiania, Norway. Filed Aug. 17, 1910. Mounted on the engine shaft is a contact in an auxiliary ignition circuit that is engaged by another contact when the speed of the shaft decreases below a certain value.

1,007,211. ELECTRIC ARC LAMP. Max Körting, Leutzsch, near Leipzig, Germany, assignor to Körting & Mathiesen, Aktiengesellschaft, Leutzsch, Germany. Filed Nov. 22, 1909. Includes an impedance adapted to replace the electrodes, an electromagnetic switch for connecting the impedance in circuit, and a winding for the switch connected in shunt to the electrode circuit and having its circuit in inductive relation with respect to the impedance.

1,007,221. TRAIN GENERATOR AND DRIVING MECHANISM THEREFOR. William M. McDougall, East Orange, N. J. Filed June 10, 1910. The driving mechanism for an axle-driven electric generator comprises a Cardan shaft positively driven from the axle, a gear box on the truck, a generator on the car body, a flexible shaft arranged to drive the generator, and intermeshing gears in the box respectively joined to the Cardan shaft and flexible shaft.

1,007,232. ATTACHMENT FOR PIANOS OR THE LIKE. Albert D. Palmer, Pittsburgh, Pa., assignor to John Gernert, Pittsburgh, Pa. Original application filed May 14, 1909. Divided and this application filed Jan. 16, 1911. An electric circuit is closed by the pedal and through an electromagnet operates a drumstick on a bass drum auxiliary to the piano.

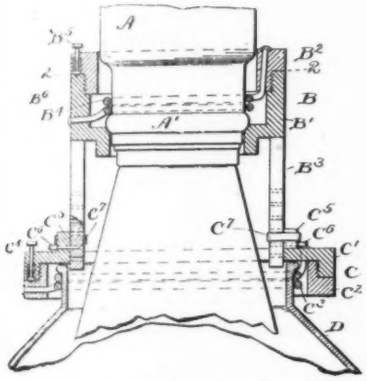
1,007,235. SIGNALING DEVICE. Francis J. Poinan, Rochester, N. Y., assignor of one-half to Franklin Decker and one-fourth to Josiah B. Brewer, Rochester, N. Y. Filed Apr. 19, 1910. An oil or gas lamp for a vehicle has a thermostatic circuit-closer in the top of its casing which, when the lamp goes out, closes a battery circuit, including a small auxiliary electric lamp on the inner back wall of the casing.

1,007,243. ELECTRIC SIGNAL. Edward Seget, Warsaw, Russia. Filed June 8, 1909. A railway signal includes a double-arm lever operating the semaphore and in turn controlled by an electromagnetic mechanism.

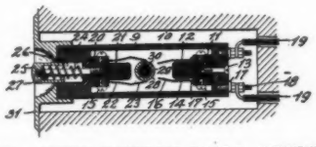
1,007,265. METHOD OF AND MECHANISM FOR PRODUCING MUSICAL SOUNDS. George Breed, Philadelphia, Pa., assignor to Lyrachord Co., New York, N. Y. Filed Sept. 23, 1909. Consists in electromagnetically actuating vibratory sonorous members and pulsating the respective exciting currents by forced vibrations induced by the vibrations of the sonorous members and having a required phase-relation to the respective magnetic impulses.

1,007,284. ILLUMINATING DEVICE. Allan J. Horner, Cleveland, Ohio. Filed Dec. 3, 1910. An inclosure contains an electric lamp, a battery, a metallic plate and push button for closing the lamp circuit.

1,007,291. CONTINUOUS ELECTRIC SWITCH. Frederick M. G. Johnson, Montreal, Quebec, Canada. Filed Dec. 26, 1908. A flush wall switch of the push-button type comprises a pair of spring contact fingers, a reciprocating member with a similar pair of spring fingers and a loose contact-making roll adapted to be engaged by one or the other pair of spring fingers.



1,007,122.—ADJUSTABLE REFLECTOR HOLDER.



1,007,291.—PUSH-BUTTON WALL SWITCH.

1,007,295. GAS AND ELECTRIC LIGHT FIXTURE. Rudolph T. Kachel, Cleveland, Ohio. Filed Jan. 27, 1911. At the lower end of the tubular stem is a clamp for rigidly fixing a radially extending arm.

1,007,344. TELEPHONE-SYSTEM SIGNALING APPARATUS. John Erickson, Chicago, Ill., assignor to Automatic Electric Co., Chicago, Ill. Filed Feb. 5, 1910. Includes a line relay, a line lamp signal controlled thereby, means for energizing the relay over the line, and mechanical means for locking the relay in energized position.

1,007,359. CASING FOR LAMP SOCKETS. Charles J. Klein, Milwaukee, Wis., assignor to Cutler-Hammer Manufacturing Co., Milwaukee, Wis. Filed Dec. 7, 1908. The casing comprises two parts, means being furnished for fastening the parts together, and for releasing the catch holding them in position.

1,007,364. SOCKET FOR INCANDESCENT ELECTRIC LAMPS. Julius K. Lux, Jersey City, N. J., assignor to Pass & Seymour, Inc., Solvay, N. Y. Filed Mar. 25, 1909. The enclosing cap and shell have a number of engaging parts, so that the shell may be attached and secured in any one of a number of positions.

1,007,373. BRACKET TELEPHONE. William C. Moeller, Doon, Iowa. Filed Dec. 2, 1909. A cylindrical case in the tubular standard member contains the contact arm actuated by the receiver lever. The telephone is affixed to a lazy-tongs lever which swings on a bracket.

1,007,386. AUTOMATIC SWITCH. John L. Polk, Troy, N. Y. Filed Sept. 2, 1910. Combines a circuit to be opened, a circuit to be closed, means including a movable member for opening the first circuit and closing the second circuit, actuating mechanism for shifting the position of the member, a handle carried by the movable member and connected with the actuating mechanism for disengaging the movable member from the actuating mechanism.

1,007,387. AUTOMATIC SIGNAL DEVICE. Frank Porto, Baltimore, Md. Filed Apr. 27, 1910. Comprises a plurality of conductors divided into blocks, bridges including magnets connecting two of these conductors in every block, bridges controlled by the magnets connecting conductors in adjacent blocks. Another set of bridges, including magnets, connects the conductors in adjacent blocks, recording means in a station being controlled by the last-mentioned magnets.

1,007,388. ELECTROLYTIC METHOD OF REFINING IRON. Alexander S. Ramage, Buffalo, N. Y. Filed Mar. 7, 1911. Consists in electrolytically dissolving impure iron in an acid ferric liquor, and then electrolyzing the resulting ferrous liquor in a cell provided with a diaphragm and insoluble anodes. In this way a cathodic deposit of iron of high purity is obtained.

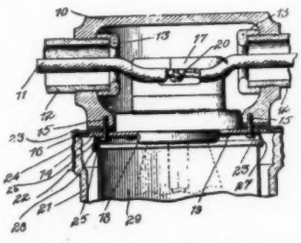
1,007,402. MOTOR-CONTROLLING DEVICE. Lewis L. Tatum, Milwaukee, Wis. Filed Feb. 11, 1910. A pivoted resistance-controlling element is moved by an operating element, also pivoted. The connection between the two elements may be broken by an electromagnet which actuates a catch, or it may be broken independent of the electromagnet.

1,007,404. PORTABLE ELECTRIC LAMP. Edgar M. Tyler, Detroit, Mich., assignor of one-half to Richard J. Welsh, Kalamazoo, Mich. Filed June 5, 1911. A casing of sufficient size to hold the lamp is provided with a base to which is fitted a lamp socket. The base is reversible so that the lamp may be used either inside the tube or outside it.

1,007,419. PLURAL LAMP SOCKET. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Co., Chicago, Ill. Filed July 27, 1906. Comprises a hollow metallic base provided with a coating of fictile material, lamp-engaging contacts, binding terminal pieces electrically connected with the contacts, and means extending through the base for securing the terminal pieces to the base.

1,007,420. OUTLET BOX. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Co., Chicago, Ill. Filed July 19, 1907. Combines a casing, a cover, a lamp receptacle supported in the casing, and a globe support clamped to the casing with the cover.

1,007,435. HEADLIGHT. Robert M. Dooley, Rockland, Tex. Filed Jan. 27, 1910. The electrodes are supported by a tubular vertical stand which also holds a reflector. The solenoid for feeding the upper carbon is located inside the tubular stand and operates through a lever and ring clutch.



1,007,420.—OUTLET BOX.

1,007,438. TROLLEY-POLE SUPPORT. Andrew Feja, St. Louis, Mo. Filed July 2, 1910. A spring-controlled rocker bar mounted on a pivoted plate carries the trolley pole.

1,007,441. ELECTRIC HEATER AND PROCESS OF CONSTRUCTING THE SAME. William S. Hadaway, Jr., East Orange, N. J., assignor to Westinghouse Electric & Manufacturing Co. Filed Mar. 15, 1909. Sheets of absorbent material, preferably asbestos, are soaked in japan and then baked. The sheets are recoated, the resistance wire put in place between them, and the whole baked under pressure. A covering of sheet metal is finally applied and the whole coated with japan.

1,007,446. ELECTRIC HEATER. Allan F. Jacobson, New York, N. Y. Filed Aug. 6, 1910. Comprises a semi-cylindrical shell, parallel resistance coils extending longitudinally within the shell and a series of insulated lugs secured within the shell for suspending the shell in operable position.

1,007,456. CONTROLLER FOR ELECTRIC MOTORS. Frederick W. Lacey, Bournemouth, England, assignor to Westinghouse Electric & Manufacturing Co. Filed Mar. 2, 1910. Is provided with mechanism independent of the main drum for locking the reverser drum in its off position and for preventing the reverser drum handle from being returned to the off position and removed except when said drum is in the off position.

1,007,457. COIL SUPPORT FOR DYNAMO ELECTRIC MACHINERY. Benjamin G. Lamme, Pittsburgh, Pa., assignor to Westinghouse Electric & Manufacturing Co. Filed Apr. 13, 1905. The combination with a core, a frame and a winding, portions of which are located in a plurality of slots in the core, of a plurality of bracing supports each of which fits between end portions of the winding that occupy different planes and against the outer members of the end portions.

1,007,466. SPARK PLUG. Harry Ellsworth Maher, Devils Lake, N. D. Filed Feb. 18, 1911. One electrode is made in oblong form to provide a plurality of spark points.

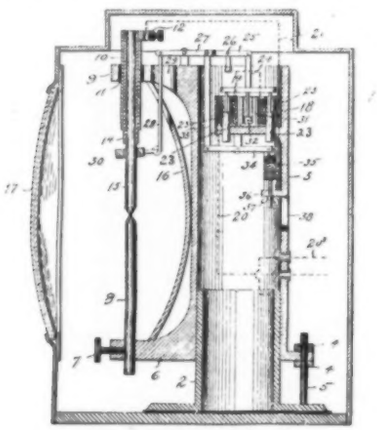
1,007,469. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES.

Frederick S. Martin, Edgewood Park, Pa., assignor to Westinghouse Electric & Manufacturing Co. Filed Oct. 18, 1909. The bars are held in place by two sets of V-shaped concentric superposed clamping rings which are independently adjustable, the inner rings of the set tending to draw the bars together and the outer to force them radially outward.

1,007,480. ALTERNATING-ELECTRIC-CURRENT-DISTRIBUTION SYSTEM. Gilbert North and John Sedgwick Peck, Manchester, England, assignors to Westinghouse Electric & Manufacturing Co. Filed Apr. 12, 1909. Has main and auxiliary transformers, a switch for controlling the connection of one of the transformers, a relay comprising contact terminals for governing the operation of the switch, circuits which include contact terminals of the switch, and a single actuating coil in the main distributing circuit.

1,007,482. ALTERNATING-CURRENT-TRANSFORMER SYSTEM. John Sedgwick Peck, Manchester, England, assignor to Westinghouse Electric & Manufacturing Co. Filed Oct. 7, 1909. The combination with a main transformer, an auxiliary transformer, and a switch for automatically short-circuiting the auxiliary transformer, of an indicating device connected across the terminals of the main transformer winding, and a switch in the circuit of the indicating device that is closed when the automatic switch for the auxiliary transformer is in its open position, and vice versa.

1,007,506. COIL SUPPORT FOR DYNAMO ELECTRIC MACHINES. Egbert M. Tingley, Pittsburgh, Pa., assignor to Westinghouse Electric & Manufacturing Co. Filed Feb. 20, 1906. Renewed Dec. 21, 1906. A core supported on a stationary frame is provided with a number of slots in which the winding is partially located. A coil support for the winding comprises a base strip having end and intermediate projections. Means are provided for attaching the strip to the frame, a cap being removably attached to the outer extremities of the projections.



1,007,435.—HEADLIGHT.

1,007,513. ELECTRIC PROCESS FOR DRYING TIMBER. Alfred Upton Alcock, Perth, Western Australia, Australia. Filed Nov. 4, 1910. Liquid electrodes, into which the circuit terminals are immersed, are applied at the ends of the timber.

1,007,544. POLICE SIGNAL SYSTEM. Alfred K. Dement, Pittsburgh, Pa., assignor to United States Police & Fire Signal Co., Pittsburgh, Pa. Filed Oct. 12, 1910. Comprises a call box having a grounded signal, normally open circuited, a two-wire circuit leading from a central station to the box, a source of direct current at the central station, a source of alternating current also at the central station, a switch for connecting either of the sources with the two-wire circuit, a relay device at the call box having a circuit which is responsive to alternating current but irresponsive to direct current, means controlled by the relay device for closing the circuit of the signal, and a third wire leading from the central station to the signal.

1,007,545. SIGNAL SYSTEM. Alfred K. Dement, Pittsburgh, Pa., assignor to United States Police & Fire Signal Co., Pittsburgh, Pa. Filed Mar. 17, 1911. Has a two-wire metallic circuit, the wires of which have a normally open ground connection at the distant end of the system. Means are provided for normally supplying current to the wires, and for abnormally energizing the wires to close the open ground connections whereby they may be used as separate grounded circuits.

1,007,562. BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES. Frederic C. Hanker, Wilkinsburg, Pa., assignor to Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. Filed Oct. 7, 1908. Has a pair of brush guides, the central planes of which are paralleled to each other, and are inclined with reference to the adjacent commutator surfaces. A pair of contact brushes are mounted in the guides with means for forcing the brushes in opposite directions against the surfaces of the commutator.

1,007,568. VAULT. William H. Hollar, Philadelphia, Pa. Filed Mar. 3, 1911. A metal door is made so that it fits in place tightly at normal temperatures. Heating coils are arranged around the periphery of the door so that when current is turned on the door expands and becomes very tightly set in place. Refrigerating coils are in the door so that the door may be cooled, when the metal will contract to such an extent as to allow the opening of the vault.

1,007,574. HOT-BEARING ALARM. Raymond L. Jobson, Kinston, N. C. Filed May 13, 1910. A tube of mercury is placed in circuit with a bell and battery, one contact being the mercury and the other a fixed metal electrode. When the mercury expands the circuit is closed and an alarm sounded.

1,007,575. TELEPHONE SYSTEM. Henry F. Joeckel, Camp Point, Ill. Filed Mar. 16, 1911. A normal ground branch at each station contains an annunciator, the branches being divided upon both sides of the metallic circuit so as to balance the metallic circuit. At each substation is a magneto with means to connect it to ground from either side of the metallic circuit and to signal any station upon their respective sides by a signaling code, or to bridge the magneto into the metallic circuit, or to normally cut the magneto out of circuit.

1,007,617. COIL SUPPORT FOR DYNAMO ELECTRIC MACHINERY. Egbert M. Tingley, Pittsburgh, Pa., assignor to Westinghouse Electric & Manufacturing Co. Filed Apr. 10, 1905. The coils, which exttend beyond the core slots of a dynamo-electric machine, are supported by a series of insulating blocks held in place by brackets.

REISSUES.

13,301. PULL SOCKET FOR ELECTRIC SWITCHES. Frederic Barr, New York, N. Y. Filed June 29, 1911. Original No. 958,988, dated May 24, 1910. Has one or more stationary switch contacts and a rotatable switch member consisting of a continuous ring and spring contact arms integral therewith cut from metal outside and reflexed beneath the ring and connected to it by bent portions.

13,305. MEANS FOR AUTOMATICALLY ARRESTING TALKING MACHINES. Arthur E. Spencer, San Francisco, and Frank C. Thomas, Mill Valley, Cal. Filed Aug. 17, 1911. Original No. 998,807, dated July 25, 1911. A brake for bearing on the edge of the record is controlled by an electromagnet whose circuit is closed when the needle approaches the end of the groove.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired November 6, 1911:

528,529. PLUG FOR ESTABLISHING ELECTRICAL CONNECTIONS. Charles W. Brown, Montreal, Can.

528,547. ELECTRICALLY-OPERATED ELEVATOR. Elias Marshall, Boston, Mass.

528,564. ELECTRICAL RETOUCHER. Charles M. Savage, Warren, Pa.

528,566. COMBINED MUNICIPAL TELEGRAPH AND TELEPHONE SYSTEM. Harry M. Seitzinger, Wilkes-Barre, Pa.

528,589. ELECTRIC BURGLAR-ALARM. Wilmot A. Brownell, Boston, Mass.

528,591. TELEGRAPHIC AND TELEPHONIC EXCHANGE SYSTEM. Wallace Childs, Fort Smith, Ark.

528,592. TELEPHONY. Frank R. Colvin, New York, N. Y.

528,608. UTILIZING ELECTRIC MOTORS FOR OPERATING MACHINERY. Ernest Richter, Berlin, Germany.

528,615. SWITCH-OPERATING MECHANISM FOR HOISTING MACHINERY. Alton J. Shaw, Muskegon, Mich.

528,616. CRANE. Alton J. Shaw, Muskegon, Mich.

528,618 and 528,619. HOISTING MACHINERY. Alton J. Shaw, Muskegon, Mich.

528,620. ELECTRIC HOISTING MACHINERY. Alton J. Shaw, Muskegon, Mich.

528,621. HOISTING MACHINERY. Alton J. Shaw, Muskegon, Mich.

528,642. ELECTRIC-ARC LAMP. Alfred H. Moses, Jr., New York, N. Y.

528,647 and 528,648. STORAGE BATTERY. Charles J. Reed, Philadelphia, Pa.

528,672. CIRCUIT CLOSER. Henry J. Hovey, Oak Park, Ill.

528,678. ELECTRIC ALARM CLOCK. Michael McDonnell, New Bedford, Mass.

528,684. ELECTRIC-ARC LAMP. Charles E. Ongley, New York, N. Y.

528,740. SECONDARY BATTERY. Elias M. Poston, Springfield, Ohio.

528,778. ELECTRICAL TRANSFORMERS. Rudolph M Hunter, Philadelphia, Pa.

528,788. BOND FOR ELECTRIC RAILWAYS. Henry B. Nichols and Frederick H. Lincoln, Philadelphia, Pa.

528,870. APPARATUS FOR MEASURING ELECTRICITY. William Friese-Greene, London, England.

528,881. ELECTRIC LEAK ALARM. Charles C. Kahne, Andrew A. Adkins, Winfield S. Pierce, John E. Martin and George F. Kahne, Ashland, Ky.

528,898. RAILWAY ELECTRIC SWITCH. Walter V. Ash and Joseph H. Ash, Newark, N. J.

528,900. ELECTRIC SWITCH. Frank G. Bolles, Washington, D. C.